Journal of the Society of Arts.

FRIDAY, MAY 10, 1867.

Announcements by the Council.

ORDINARY MEETINGS.

Wednesday Evenings at Eight o'Clock:—

MAY 15.—"On New Machinery for Cutting, Tunnelling, Quarrying, and Facing Slate, Stone, and Marbles." By W. FOTHERGILL COOKE, Esq.

May 22, Derby-day.—*No meeting.*

CANTOR LECTURES.

The concluding lectures of Mr. CHAFFERS' course, "On Pottery and Porcelain," will be delivered as follows:—

LECTURE VI.—MONDAY, MAY 13TH.

ENGLISH POTTERY.—Fulham—Lambeth—Yorkshire—Shropshire—Liverpool—Staffordshire—Etruria—Wedgwood's Wares, &c.

LECTURE VII.—MONDAY, MAY 20TH.

ENGLISH PORCELAIN.—Bow—Chelsea—Derby—Worcester—Liverpool—Wales—Plymouth—Bristol—Lowestoft—and other Manufactories—Battersea Enamel, &c.

The lectures commence at eight o'clock, and are open to members, each of whom has the privilege of introducing one friend.

CONVERSAZIONE.

The Council have arranged for a Conversazione on Thursday evening, the 23rd May, at the South Kensington Museum, cards for which will shortly be issued.

ARTIZANS' VISITS TO PARIS.

The Council of the Society of Arts, feeling the importance of promoting the intelligent study of the Paris Exhibition and the manufacturing establishments in France by artisans of the United Kingdom, have appointed a Committee in furtherance of this object. The following gentlemen constitute the Committee:—

Rt. Hon. C. B. Adderley, M.P.
C. W. Aitken.
Edward Akroyd, M.P., *Vice-Pres.*
Sir Wm. G. Armstrong, C.B.
A. S. Ayrton, M.P.
S. A. Beaumont.
John Bell, *Memb. of Council.*
Professor Bentley, *Memb. of Council.*
Lord Berners, *Vice-Pres.*
Hon. and Rev. S. Best.
D. Roberton Blaine, *Memb. of Council.*
W. H. Bodkin (Assistant-Judge), *Vice-Pres.*
Sir J. P. Boileau, Bart., *Vice-Pres.*
R. K. Bowley.
Antonio Brady.
Rt. Hon. H. A. Bruce, M.P.
Decimus Burton.
C. Buxton, M.P.
The Earl of Caithness, *Vice-Pres.*
Lord Eustace Cecil, M.P.
R. L. Chance.
Harry Chester, *Vice-Pres.*
The Masters of the City Companies.
Henry Cole, C.B., *Vice-Pres.*
Robt. Coningsby.
Rt. Hon. W. Cowper, M.P.
Sir Francis Crossley, Bart., M.P.
J. Bailey Denton, *Memb. of Council.*
Lord de l'Isle and Dudley, *Vice-Pres.*
The Duke of Devonshire.
Charles Dickens.
James Easton, *Memb. of Council.*
C. W. Eborall.
Lord Ebury.
Lord Elcho, M.P.
William Fairbairn, F.R.S.
Professor Fawcett, M.P.
Peter Graham, *Memb. of Council.*
The Earl Granville, K.G., F.R.S., *Vice-Pres.*
The Earl Grosvenor.
Mr. Hansard.
G. W. Hastings.
Wm. Hawes, F.G.S., *Vice-Pres.*
J. Pope Hennessy.
Sir Rowland Hill, K.C.B.
Chandos Wren Hoskyns, *Vice-Pres.*
T. Hughes, M.P.
Blanchard Jerrold.
Rev. C. Kingsley.
Hon. A. F. Kinnaird, M.P.
Lord Henry G. Lennox, M.P., *Vice-Pres.*
The Bishop of London.
The Sheriffs of London and Middlesex.
Rt. Hon. Robt. Lowe, M.P.
Lord Lyttelton, *Vice-Pres.*
Archbishop Manning.
Henry Maudslay, *Memb. of Council.*
Rev. F. D. Maurice.
The Lord Mayor.
J. Stuart Mill, M.P.
Rev. Dr. Miller.
The Bishop of Oxford.
J. Slaney Pakington, *Memb. of Council.*
Right Hon. Sir John S. Pakington, Bart., M.P., *Vice-Pres.*
Alderman Sir B. S. Phillips.
Sir Thomas Phillips, Q.C., F.G.S., *Vice-Pres., Chairman of the Council.*
The Duke of Richmond.
Rev. W. Rogers.
The Marquis of Salisbury, K.G., *Vice-Pres.*
Titus Salt.
Sir Francis Sandford, *Vice-Pres.*
Colonel Scott, R.E., *Memb. of Council.*
The Earl of Shaftesbury.
Benjamin Shaw, *Memb. of Council.*
Sir J. P. Kay Shuttleworth, Bart., *Vice-Pres.*
S. Smiles.
Seymour Teulon, *Treasurer.*
Thomas Twining, *Vice-Pres.*
Alderman Waterlow, *Memb. of Council.*
E. W. Watkin, M.P.
G. Watts.
George F. Wilson, F.R.S., *Memb. of Council.*
Vice-Chancellor Sir Wm. Page Wood, F.R.S., *Vice-Pres.*

The Council, on the recommendation of the Committee, have passed the following minute:—

At the last and former International Exhibitions held in this country, arrangements were made by the French Government to facilitate the visits of skilled artizans, and interesting reports on the exhibitions were made by them to their government. Believing that such visits on the part of skilled workmen to these great international displays not only exercise a beneficial influence upon the men themselves, but also upon the progress of industry in the country to which they belong, the Council of the Society of Arts have resolved to raise a fund to be employed in aiding a limited number of English workmen to proceed to Paris for the purpose of studying the present French Exhibition.

To carry this object into effect, they have agreed on the following plan:—

1st. That a number of selected workmen (the number to depend on the amount of funds at the disposal of the Council) shall be assisted to proceed to and remain in Paris a sufficient time (say three weeks), for the purpose of making a careful study of the exhibition, and of such factories and workshops as they may desire to visit.

2nd. That every man so assisted shall, on his return, make a report to the Society of what he has observed during his stay, in reference to the special industry in which he is engaged, and that it be made a condition of the grant to each man that one-third of the amount be retained until his report shall be supplied to the Society.

3rd. The Council think it will be undesirable to fix the exact time for, or to prescribe the duration of, these visits, or to interfere with any of the arrangements the

men may desire to make for their own accommodation; but, in order that they may take advantage of the facilities provided by the Commission organised by the French Government for the study of the exhibition, the men will be placed in communication with that Commission on their arrival in Paris.

4th. A considerable sum will be required satisfactorily to accomplish the important object undertaken by the Society, and, in order to raise these funds, the Council have determined to appeal to the members of the Society, who must be interested in the successful results of this movement, in the belief that they will not hesitate to join in a subscription for the furtherance of the undertaking; and they propose at the same time to communicate with the various Chambers of Commerce, inviting their counsel and support. The Council have decided to commence the subscription by a vote of one hundred guineas from the funds of the Society.

Members are invited to aid the Council in this undertaking by subscriptions, which should be forwarded to the Financial Officer at the Society's house.

HARVESTING OF CORN IN WET WEATHER.

The Council of the Society of Arts have resolved to offer the Gold Medal of the Society, and a Prize of Fifty Guineas, for the best Essay on the Harvesting of Corn in Wet Seasons.

The first part of such essay—after noticing the various systems at present adopted in damp climates for counteracting the effects of moisture upon cut corn in the field, and for avoiding such exposure in wet seasons by peculiar harvesting processes—should furnish a practical and analytic exposition of the best available means:—

1st. Whereby cut corn may be protected from rain in the field.

2nd. Whereby standing corn may, in wet seasons, be cut and carried, for drying by artificial process.

3rd. Whereby corn so harvested may be dried by means of ventilation, hot air, or other methods; with suggestions for the storage both in the ear and after threshing.

4th. Whereby corn, sprouted, or otherwise injured, by wet, may be best treated for grinding or feeding purposes.

The whole to be supplemented by a statement of practical results, and actual cost of each system described; and authenticated estimates of any process proposed for adoption, based upon existing but incomplete experiments.

The above requisitions are given suggestively; not to bind the writer to the order or to limit the treatment of the subject, provided it be kept within the scope of practical experience and utility.

The essays must be sent in to the Secretary of the Society of Arts on or before the 1st of January, 1868.

The Council reserve the power to withhold the whole or part of the prize, in the event of no essay being, in the opinion of the judges, of sufficient merit.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

Proceedings of the Society.

FOOD COMMITTEE.

A meeting of the General Committee on the Food of the People was held on the 11th April. Present—Mr. Benjamin Shaw in the chair: Mr. J. Caird, Mr. Harry Chester, Mr. C. Wren Hoskyns, Lord de L'Isle, Mr. Clare S. Read, M.P., Mr. E. C. Tufnell, and Professor John Wilson.

Professor WILSON laid before the Committee the following information on the subject of bread-food and the nutritive properties of wheat, more especially with reference to a system of grinding and dressing corn and the process of panification which had resulted from the investigations of M. Mège-Mouriés, of Paris. Previously to so doing, Professor Wilson called the attention of the Committee to a diagram of a section of a grain of wheat greatly magnified, showing the disposition of the outer ligneous envelopes and the internal cellular tissues in a very distinct manner. Professor Wilson stated that he need not go into the question, which everyone present no doubt understood, as to the different properties of alimentary substances, which might be divided into two classes—one which subserves the plastic purposes of the body, and the other which subserves the respiratory process generally; and that for healthy life these must be had in definite proportions, these proportions being about six of the respiratory aliment to one of the other; wheat, better than any other grain, possesses those two alimentary principles in the proper proportions; consequently wheat has been generally looked upon as the bread corn of all civilized nations; as people progress in civilization they give up the old barley and rye, and employ wheat solely for that purpose. About twelve years ago (1853-54) M. Mège-Mouriés directed his attention to the composition of the grain of wheat, and to the processes of grinding and of panification, and the results he obtained were sufficiently important to form the subject of a report, which was presented to the Academy of Science by M. Chevreul, in 1857. The object of M. Mouriés' investigation was to show the defective knowledge and the waste of material in the ordinary practices of the trade; but, although these were fully proved by his results, there appeared to be trade and other difficulties in the way of its general adoption; for, with the exception of some of the large public establishments in Paris, including the Ecole Polytechnique, the Ecole Normale, and the Lycée St. Louis, where it was carried out with marked success and advantage, no good has practically resulted from the principles he so ably marked out and made known to us. In the summer of 1865, while acting as juror on food substances at the Dublin Exhibition, Professor Wilson's attention was recalled to the subject by an article which was exhibited under the name of "Cerealine," and purported to be a preparation of wheat flour by the process indicated by M. Mège-Mouriés. On examination this preparation replied to the tests in a very satisfactory manner, so much so, indeed, as to induce them to verify them by a determination of the nitrogen it contained. This confirmed the opinion they had previously formed of its food value. On further inquiry he found that a simple mechanical process had been devised in the United States, (where, indeed, the flour exhibited had been prepared) for effecting the most difficult part of M. Mouriés' process—that of decorticating the grain. This renders the operation of preparation so easy and so inexpensive as to make it desirable that attention should again be called to M. Mouries' process, for, besides being far more philosophical, it unquestionably effects a large saving in a food point of view, as compared with

the ordinary practice of mealing. Before describing M. Mouriés' process it may be well, for the purposes of comparison, to give in a few words a rough outline of the ordinary process of grinding, breadmaking, &c. The wheat is taken in its natural state and submitted to the friction of two stones between which it is placed. It is then passed through sieves for the purpose of—1st, separating the bran from the flour; and, 2nd, of separating the finer from the coarser portions of the flour. We thus have three principal divisions; the two latter again are sometimes further separated, and various names—boxings, sharps, &c.—given to them. The bran averages from 14 to 15 per cent. of the whole weight, the relative proportions of the residue vary according to the differences of separation. In examining the composition of the grain of wheat, M. Mège-Mouriés found that it was a far more complicated structure than was commonly understood. This structure consists—1st, of an outer covering or epidermis; 2nd, epicarp; 3rd, endocarp; and that these three layers consist chiefly of ligneous tissue, and form the extreme covering or true bran. Together they average from 2 to 3 per cent. of the weight of the wheat. The three outer, or ligneous tissues, are valueless for food. They contain a certain amount of nitrogen, but are indigestible; and are not only valueless as food, but do harm as local irritants. These are distinct from the ordinary bran of the mealing process. Beneath these come, 4th, the "testa," or seed coat proper, which is a distinct cellular tissue of a dark colour, yellow or orange, according to the description of the grain. Next to that comes the embryonic membrane, directly connected with the germ, which indeed it supplies as soon as the vital processes of growth are excited. These two enveloping membranes contain nitrogenous principles in larger proportion than the interior portions of the grain; and as we go from the exterior coverings to the centre and follow the starch granules, the amount of nitrogenous compounds diminishes. The ordinary bran not only consists of the "epidermis," or true bran, but also contains the whole of the nitrogenised tissues enveloping the starch granules, and always a certain proportion of them also. Indeed, it has been found commercially profitable to purchase bran and separate the starch or flour from it; from 5 to 6 per cent. of flour are thus often obtained. As already stated, the ordinary bran averages from 14 to 16 per cent. of the weight of the wheat. It is the same in the case of the potatoe. We throw away a good deal of valuable food in the peeling of potatoes. We ought only to remove the epidermis. Simple experiment shows that.

Mr. Read inquired whether the same remark applied equally to linseed?

Professor Wilson thought that the same law would hold good in all similar vegetable structures. Linseed does not contain starch, but the cells contain oil instead. The nitrogenous compounds do not exist in the starch granules, but they envelop them. As you approach the centre of the wheat grain the starch cells do not contain so much nitrogenous compound as the other tissues. He might further state that the embryonic memb. plays the most important part, both in alimentation and germination. That is the active agent of decomposition during the process of panification. The outer covering of wheat when immersed in water speedily becomes saturated with water, but if Na Cl. (salt) be added, the solution only penetrates so far as this membrane, where it is arrested. These two inner tissues contain nitrogen in large proportions, and envelope the mass of starch cells which form the body of the grain. Ordinary flour is composed entirely of these interior starch cells, the remaining portions of the grain being separated in the shape of bran, and carrying away with them at the same time a proportion—generally 5 or 6 per cent. of the flour also. M. Mouriés found that the proportion of nitrogenous compounds in the grain was very unequally divided; that while in the epidermis proper it was least, it existed in larger proportions in the two next layers than it did in the starch cells or flour of the interior, and, consequently, if we would preserve the maximum food properties of the grain, we must return and combine those two layers with the flour, and not waste them by separation with the bran. In the starch cells or flour too the nitrogen was found to diminish towards the centre of the grain, where it was at its minimum, and where of course the flour, though finer and whiter, has the least nutritive value. This is known practically by the fact that the finest wheat flour will not combine with so large a proportion of water in breadmaking as the second quality will, though it may not be so well known that the cause is due to the smaller proportion of gluten present. It has been found by experiment that the finest flour will not take up more than 20 per cent. of water, known as *pain blanc*; that the second quality will take up 30 per cent., *pain de gruaux*; while the third quality, with which a portion of the ordinary bran is always mixed, will take up 40 per cent. *pain bis*. M. Mouriés, therefore, recommends that the grain should be merely decorticated previous to grinding, and that the layers of cells, so rich in gluten as the testa and embryo membrane, shall be ground up with the starch cells, and form part of the flour used for bread and other food purposes. The bread thus made absorbs more water, rises from 20 to 30 per cent. more, and is more nutritive as well as digestible. Gluten is the nitrogenous property of the wheat, and by the greater absorption of water by the flour in which it is present, weight for weight of flour there is a gain, in the greater number of loaves produced from a given weight of flour, and that would be the baker's inducement to try this process. It would be at the same time more nutritious, owing to the greater proportion of nitrogenous matter the loaves contain. The loaves will contain more water, but the extra proportion of nitrogenous compounds will counter-balance that. One hundred parts of flour of this sort will make say 140 loaves, whereas 100 parts of the other flour would only make 100, and every one of the 140 would be more nutritious than the other. This process may be said to add 60 per cent. to the nutritive value of the flour, while the bulk is only increased 40 per cent.

Mr. Caird inquired whether any difference was found to exist in this respect, according to the description of wheat,—red or white, and that sown in spring and autumn?

Professor Wilson replied, within an extremely limited range; all descriptions being subject to the same laws. There was, no doubt, a difference in the varieties of wheat and soil, and the period of sowing, whether spring or autumn, but the range was too limited to be of the slightest importance. He did not think that was a question which need be considered now. The true bran, according to M. Mouriés, consists of only the outer coverings, the ligneous tissues, which represent three to four per cent. of the whole. He was only speaking of the wheat as it is in the market; and as we are told we shall probably require 8,000,000 quarters of foreign wheat, it is a matter of vast importance to utilise the grain to the utmost extent it admits of. There is another point of importance in connexion with M. Mouriés' process, in regard to the storage and preservation of wheat. It appears that the outer covering—epidermis—absorbs moisture far more readily than the regular cellular tissues of the inner layers, and this renders the grain more or less liable to mould, and other injuries, unless great care be taken by occasional shifting, &c. If you soak wheat grains in water, you will find that the water is readily absorbed by the outer or ligneous tissues, and when you come to the inner tissue there is no longer the same tendency to absorb, consequently, if you moisten the outside surface, and rub it gently, you will rub these tissues off the grain, and the grain will come out in this shape [producing speci-

mens of decorticated grain]. That is, the absorbent envelopes will be taken off, and nothing will remain but the cellular tissues, and in that state wheat may be kept stored for any length of time without its quality being impaired.

Mr. CHESTER asked if this had been proved by any experiment on a large scale.

Professor WILSON—It has been so stated; but I should not be satisfied without further trial, because a great deal of information on the subject has been taken from American sources. The theory is correct with regard to the keeping properties of wheat, the decorticating process needs further proof. On the Continent this question is more important, where they have government stores of wheat to last for twelve months, whereas we have free markets. When the wheat is decorticated it can be kept for years without a chance of mustiness or mould getting on it. He would give the Committee the relative values of these different preparations [referring to samples on the table], assuming that the proportion of nitrogenous compounds determines the nutritive value, and that is what we usually go upon. This sample of true bran or epidermis was taken from a very coarse sample of red wheat, and no doubt it exists in larger proportions than in the finer samples of wheat. The true bran contained 4·571 of nitrogenous compounds, the ordinary bran of the market contained 15·019. These analyses were all carried out last winter in Edinburgh. Of ordinary market flour he got three samples, and made an analysis of each, and he found they contained on an average 9·795 whereas the flour prepared by M. Mouriés' process contained 15·672 per cent. of nitrogenous compounds, showing an excess in nutritive value of 60 per cent. over the ordinary flour. The average proportion of bran is 14 to 15 per cent., while by M. Mouriés' process it is only from 3 to 4 per cent.; we thus have a result of 10 per cent. addition in weight and 60 per. cent. more of nutritive properties than by the old process, and at the same time we deprive the wheat of those portions which render it not so well able to be kept. As he had already stated, wheat, by this process of decortication, has less affinity for moisture, and may be stored with less risk. The flour contains more gluten, absorbs more water in panification, and makes more bread, which retains its freshness. All smut and other dirt from insects or otherwise is removed, and the phosphates as well as gluten are preserved. The gluten obtained in starch manufacture has been utilised by mixing it up into bread with ordinary flour, and thus greatly improving its quality. In this case, the same result is obtained by simply not losing it in the ordinary bran. M. Mouriés' plan has, in fact, more nutritive value than the actual whole wheat, because you take away this three or four per cent. of what is no good whatever, and the 96 per cent. left behind contains a higher percentage of nutritive value than the whole wheat does. Thus it appeared to him that M. Mouriés' process increases the quantity of food material obtained from wheat by at least 10 per cent., because here we have only four per cent. of valueless matter, while in the ordinary process we have 14 per cent., so that we get an improved quantity of 10 per cent., and when we come to the manufacture of the flour we get an improvement of 60 per cent. upon the value. M. Mouriés' flour was found to be equal to 15½, whereas the ordinary flour was equal to only 9¾. The grain would weigh heavier, bulk for bulk, after decortication, as it would pack closer, owing to the smoothness of the surface. We find that the nearer wheat assumes the form of a sphere, the heavier it is per bushel, and the specific gravity of the grain is a market test of its quality. Chidham wheat is heavier than Talavera wheat, and yet the latter usually fetches a higher price in the market. A bushel of Talavera wheat weighs about 65 lbs., while the same quantity of Chidham wheat weighs from 65 to 68 lbs. That is determined chiefly by the shape of the particles. No doubt by this process the shape of the grain is altered, because in wheat in its natural state there is always a little beardy roughness, which, though invisible to the naked eye, exists, and increases the tendency to fermentation when affected by moisture, and also prevents the particles lying so close together; therefore, he should say a bushel of decorticated wheat would weigh 5 lbs. or 6 lbs. heavier than ordinary wheat.

Mr. READ asked what was the commercial value of the epidermis?

Professor WILSON replied *nil;* it was only fit to be put on the manure heap. When given in food it was injurious rather than otherwise, it was so sparingly digestible. If moistened it fermented, and became sour in a few hours. The ordinary bran would not do so; this bran would act as an irritant on the stomach.

Mr. READ—Practically, by this process, you get a reduction of a substance which is of no value whatever as food?

Professor WILSON—Precisely so: whereas the other portions of the bran are of higher food value than the ordinary flour itself.

Mr. READ observed, with regard to the commercial value of the bad portions of the grain. The price of flour for the last ten years averaged 1s. 3d. per stone, while the price of bran was 9d.; therefore, though the latter was lost to the human race, it was not lost to the animal world, because it took the place sometimes of wheat meal when it was cheap relatively to other grain in the feeding of animals.

Professor WILSON—We are now looking to the higher class of animals, viz.—ourselves. Every wise feeder of animals, if he can get bran at a low price, will make use of it.

Mr. CHESTER inquired whether the ligneous portion of the bran was valuable for animals.

Professor WILSON replied that the animal organisation was better adapted for it than our own. They got rid of it easy enough. An animal, out of 14 lbs. of ordinary bran, would appropriate 10 lbs., and 4 lbs. would be expelled in the shape of manure. The ruminating process could not convert this into food value at all. Professor Wilson then proceeded to describe the process of decortication as follows: The wheat, he said, is carried up to the topmost floor, then passing through a screen, or riddle, it falls through a hopper into a long narrow trough which contains water, and is traversed through its length by an Archimedean screw. This carries the wheat slowly along the trough to the discharge end, where it now, in a moistened state, falls down a tube to the unbranning or decorticating cylinders. These are formed of cylinders of cast iron, ridged on the interior diameters, and with closed ends. A screw shaft traverses the centre of them, carrying broad arms, or floats, set at an angle diagonal or "aslant" to the face of the cylinder, and with a diameter so much less than that as to cause friction, but to allow the grain to pass without crushing. A rapid rotation is given to this central shaft, and, owing to the angle at which the floats are set, a slight progressive motion is given to the grain. The friction causes a large proportion of the true bran—epidermis, epicarp, &c.,—to be separated, and this is removed as it is separated by a blast driven through the cylinder in a direction contrary to the motion of the shaft, which also has the effect of drying the excess of moisture of the grain. The grain then passes along a spout into a second cylinder, where it undergoes the same process, and finally is carried into the drying chambers, composed of a series of iron troughs, along which it is propelled by screw shafts, a current of warm air being driven along them in an opposite direction. It then, being dry, receives its last friction in the polishing cylinders, where the friction is applied to the surface of the grains themselves, which are left in a dry, smooth, rounded form. As this generates a considerable elevation of temperature, the grain requires to undergo a cooling process before storing or using. This is effected by carrying

it up to the upper floor, and allowing it to fall down inclined planes through a flat shallow shoot, up which a blast of cold air is driven. With regard to the grinding of this prepared wheat, there are some advantages over the old system. In ordinary grinding, Professor Wilson continued, there is always a mechanical difficulty in arranging the stones. The aim of the miller is always to produce the best flour, and he has to grind it in such a manner as not to crush and cake the meal, not to allow it to heat between the stones, but to granulate it perfectly and evenly throughout, giving it the wiry feel characteristic of No. 1 flour. If set too close, or if the stones be dull, the flour cells are crushed rather than granulated; it has a soft, unctuous feel, and is then termed "killed." In that state it never mixes well, will never work up properly, or rise well in the oven. If the stones be too keen or sharp they are apt to shave and cut up the bran into fine scales, which speck the flour. Therefore, the successful miller has to steer between dull bran with deadness and sharp bran with speckiness. By this process the true bran (epidermis) is all removed, and the stones have to act on a gluten surface and not on the bran, and consequently the latter risk is avoided. In baking, care should be taken not let the dough stand too long, as is frequently done, and not to have the oven too hot at starting. The bread rises 25 to 30 per cent. more than when made with the ordinary flour, and if the heat is too great at first the crust hardens, and the panification forces the loaf out of shape. This process adds at least 10 per cent. to the weight of the food portion of wheat, while it increases the nutritive value of the flour about 60 per cent. These proportions in all probability admit of some modification, as the flour and the bran of the ordinary process of mealing were obtained in the market, while the flour and bran of M. Mouriés' process were, no doubt, obtained from a finer description of wheat than that grown in our climate. This, upon the wheat consumption of the kingdom—say, 20,000,000 of quarters—is a matter of considerable importance. By this process you get a large increase of food value, but you do not get the white bread which is so universally eaten in this country.

Mr. CHESTER inquired whether Professor Wilson could give any practical suggestion to the Committee whereby the process could be brought into notice, and whether he was aware of any public establishment, in any part of the country, where, on the advantages of the process being demonstrated, it was possible a trial of it might be induced?

Professor WILSON replied that he was not prepared with any suggestion at the moment. It was hardly a matter for private enterprise. It was a matter which might be represented to the Government or the Poor-law Board. There was no gainsaying the advantages that were derived from the process; and it might be put to them whether it was worth their while to direct a trial of it in some of the poorhouse establishments. The decorticating machinery would not be very expensive. In the first instance public prejudice to this flour would have to be overcome; he feared that it would take some time to bring the flour into favour with the lower classes, who have a proverbial preference for very white flour.

Mr. WREN HOSKYNS inquired whether flour prepared by this processs was cheaper than the ordinary fine flour?

Professor WILSON replied of course it would be, because ten per cent. increase in the quantity would more than cover the expense of the manufacture; but he rather looked upon it as the improvement in nutritive value. As he had already stated, it was computed that we should require this year foreign supplies amounting to eight millions of quarters of corn, whereas five millions of quarters treated by M. Mouriés' process would be equal in food-value to eight millions treated in the ordinary way. He added that he was thoroughly satisfied with the philosophy of the subject that it was sound, and it was owing to the circumstance of his acting as a juror on food substances at the Dublin Exhibition that his attention was called to it by seeing some of this article, the value of which the Americans were keen enough to recognise.

CANTOR LECTURES.

"ON MUSIC AND MUSICAL INSTRUMENTS." By JOHN HULLAH, ESQ.

LECTURE VIII.—MONDAY, MAY 6.

MODERN INSTRUMENTS, CHAMBER AND ORCHESTRAL.

Mr. Hullah concluded his (extended) course of lectures on Monday, the 6th inst. The last three, he reminded his audience, had been devoted to the construction and history of musical instruments. It had been seen that all modes of producing musical sound but one—the abrasion or friction of strings—were very ancient, and that every material now used in the making of instruments had been used from the earliest times. The material last applied to the production of sound—hair—had proved incomparably the most important; without the bow, music such as we now have would never have been conceived, nor could it have been executed if it had been. It must not be thought, however, that all ancient instruments were identical in size and shape with their present representatives. On the contrary, these latter had been the subjects of unceasing experiment and repeated change, down to certain epochs at which, for a time, these sizes and shapes had been fixed, by being reconciled with some natural law, by their real or apparent perfection, or by the composition for them of music in such quantity and of such merit as to ensure them against such further modification as would interfere with the execution of that music. In the last lecture it had been shown that the key-board of the 14th century could not have been essentially different in its proportions from the key-board of to-day, unless it could also be shown that the human hand had undergone some great modification. So with the holes of the flute or oboe, the strings of the harp, the frets of the guitar, all of which must be brought within easy reach of fingers of average length. But instruments may easily satisfy this condition and still be far from perfection; and, until any serious inconveniences attending their use could be overcome, it was not likely that they would inspire those who wrote for them with fresh or beautiful thoughts. The instrument has of necessity always preceded the performer, and the performer the music for the instrument; otherwise, the production of good vocal music would not have anticipated by so many generations that of instrumental. Musical instruments have decreased in number as they have improved in quality. As the performers on those of the same species have attained greater skill, the necessity for so many and such slight varieties of them has become less. The oboe and the bassoon represent, in the modern orchestra, a large number of ancient instruments of like construction; and the chest of viols of the 17th century has been replaced by the violin, the viola, and the violoncello, all of which have been extended in compass as well as in general capability. In the race of improvement the bowed instruments, the last to come into the field, have taken and kept the lead. They have also given birth to the earliest great players, and the earliest good instrumental music—evidence, which can need no commentary, of their supremacy in quality, flexibility, and power of expression. The time and place of birth of the first violin proper is still a matter of doubt. The makers of bowed instruments, in the 16th and even in the 17th centuries, did not limit the exercise of their skill exclusively to them, still less to any particular specimens of them. They made viols of all shapes and sizes, long after they had begun to make real violins; and not only these, but guitars, harps, and lutes. So little was the supremacy of the violin recognised, that the makers of stringed

instruments took their name from one now almost extinct —the lute. To this day a continental violin maker is called a *luthier*. The question of the origin of the violin had been complicated by the practice of refitting old viols with new finger-boards, and stringing them afresh. Who made the first violin proper is a question likely to remain without a satisfactory answer; but that it was made somewhere in the north of Italy, and at some time in the second half of the 16th century, is pretty certain. During the first half of that century many excellent luthiers flourished in the north of Italy. One, a native of the Italian Tyrol—Duiffoprugar, set up in Bologna in 1510. Some violins and violas extant bear his name, but closer examination has proved them to be altered and refitted viols. A little later many luthiers settled in Brescia; so many, indeed, that the school of Brescia soon attained an individual reputation. Indeed, it is likely that the violin proper is a native of Brescia,—not less renowned for *virtus* than *virtù*, for no city has contributed, by the valour of its citizens, more effectually to the recent recovery by Italy of a place among nations than Brescia. In Brescia lived, from 1560 to 1610, the celebrated Gasparo di Salo; and, a little later, Magini, a native of Brescia. But the School of Brescia is most renowned for its pupils and offshoots; since Andrea Amati was one of the former, and the school of Cremona one of the latter. Through the labours of this ingenious artist, his sons, Geronimo and Antonio, his grandson, Nicolo, his great-grandson, another Geronimo. and his and their pupils, Guarnerius and Straduarius, Cremona and the violin became literally interchangeable terms. During a great part of the 17th century, notwithstanding the now uncontested superiority of the violin, the viol family still maintained a certain position in the musical world; but towards the end of the century that position ceased to be tenable; and from that time composers and performers have worked exclusively for and with the perfect instruments which already were, and indeed had long been, at their disposal. The violin, viola, and violoncello — varieties in size only of the same instrument—have replaced the whole tribe of viole da braccio and da gamba; and to them has been added a still larger and deeper instrument, the contra-basso or double bass, which again has replaced the violone. From the identity of form of these instruments results a similarity of quality highly favourable to their combination; and this, added to their capability of perfect intonation, approximates them more closely than any other species of instrument to the human voice. No doubt their predecessors, the viols, were often played in tune, and often sounded homogeneous. The superiority of the modern violin lies in its power, quality, and flexibility, which are due to its outline, proportions, and material, to the smaller number, greater thickness, and increased tension of its strings, and to the different form and greater strength of the bow applied to them. The increased arch of the bridge (combined with the *échancrures*), while it has made the violin less available as an instrument of harmony than most of its predecessors, has given it a power and a freedom as an instrument of melody to which none of them could lay claim. In fact, the violin family seems to have attained, in the second half of the 16th century, a perfection beyond which it would seem undesirable and impossible to carry it. The modern orchestra includes all the most important varieties of the two great tribes of instruments—wind and stringed. The violin family represents almost exclusively the latter tribe. The wind instruments are of two species, those of wood and those of brass; and of each of these there are several varieties. Of the wood instruments, the flute only is a simple pipe; the clarionet, oboe, aud bassoon being reed instruments. Of the brass instruments, the trumpet and horn are, in their simplest form, mere tubes, the scales of which are limited to the notes of the harmonic chord. The trombone differs from the trumpet and horn, not only in quality but in mechanism, being a brass tube, the length of which is capable of considerable extension. The slide by which this is effected has been of late years applied to the trumpet; and valves, answering a like purpose, have been also applied to the horn. Both these inventions, however, though they afford great facility to the performer, take something from the resonance of the instruments; and their adoption has considerably altered their quality, and is gradually altering the character of the passages written for them. None of these instruments can yet be said to have attained to the status of the violin family. Perfect intonation upon them seems only attainable by persons specially gifted. So difficult is it to the clarionet player, that he is always provided with three instruments, which he uses in their turn for different scales and sets of scales. Considerable inconveniences result from this multiplication of instruments, the most important of which is the impossibility of keeping them at the same temperature, and therefore at the same pitch. This particular inconvenience is limited to the clarionet. One flute, one oboe, and one bassoon are severally used for all keys. In intonation the flute, the most popular and easiest of those instruments, is the most often in fault. The short-comings of the clarionet, oboe, and bassoon, are of another kind, relating rather to quality than to pitch. Performance on every instrument requires or is facilitated by some special physical gift of hand or lip. It is difficult enough for some persons, under the most favourable circumstances, to become good performers on the violin or pianoforte; but success on some wind instruments seems to be attainable by only a few. The trumpet proper has all but disappeared from the modern orchestra, solely on account of the difficulty of blowing it. The instruments on which trumpet parts are now commonly played are not trumpets proper, but composite, hybrid instruments, much easier to blow, and immeasurably inferior in quality. A lip strong and sensitive enough successfully to cope with the difficulties of this instrument seems to be as rare as the conformation which results in a fine tenor voice. This seemed the place, Mr. Hullah said, to speak of the qualities needed to make a thoroughly good orchestral performer—an expression which must be understood to represent a good executant, and a good deal besides. The fable of the bundle of sticks has no application to an orchestra, which is good, bad, or indifferent, in proportion to the number it contains of good, bad, or indifferent players. On some players rests a smaller weight of responsibility than on others, but all are called upon for the exercise of excessive vigilance. The stringed-instrument parts in an orchestra are severally performed by many players. Occasional relaxations of attention on the part of individuals among them may, therefore, do little harm, and escape notice. At the same time, no player in an orchestra, however large, can make a decided mistake without its being heard, and without half his collaborateurs knowing who makes it. But the wind instrument parts are all individual; no two performers play the same part. The second performer in each case, often playing from the same book as the first, may sometimes rely upon the latter; but the first performer on each pair of instruments is entirely dependent on his own presence of mind and power of attention. In the course of an oratorio or opera of average length, there are often some hundreds of changes of time or key, or both, and within the limits of each of these innumerable pauses, ralentandos, accelerandos, and sustained notes, the duration of which were subject to the will of singers, not at all bound to execute the same passage twice alike. Sometimes a particular instrument is silent during a movement, or two or three successive movements. Throughout these, unless the player knows the work well, he must count his bars of silence, that he may be prepared for re-entry, often, at some critical point, the missing of which, by an instant of time, would turn the harmony to which he should contribute to hopeless discord, and bring a thousand

execrations on his devoted head. With one eye on his music, the other on the conductor's baton, and his ears everywhere, the attention of the orchestral performer is often exercised without a moment's intermission during a performance lasting for three or four hours. A history of the orchestra would no doubt make an interesting book, certainly a large one, could the material for it be got together, which it is not likely that it ever will. Stories have come down to us, which have evidently lost nothing in the telling, of vast gatherings of vocal and instrumental performers in very distant times; but how these were composed, what proportions the instruments bore in numbers one to another, how the performers were made to work together, what sort of music they performed, all these are questions which will doubtless often be asked, with little chance of their ever being answered satisfactorily. It is pretty certain that a Greek orchestra was limited to the production of melody in unison or in the octave, accompanied by an occasional fourth or fifth above or below it, and, in passages of great intensity, by drums, cymbals, and other one-noted instrument of percussion. But the history of other arts does not justify our assuming that the music of every people, cotemporary with or anterior to the Greeks, was of the same nature as theirs. Mr. Hullah had touched on this point before, but it was so important that he would venture to repeat what he had already said. The Greeks took their arts, in the first instance, from peoples older in civilisation than themselves. They of course rejected what they found distasteful and antipathetic. Their tastes and sympathies went all in the direction of the simple and the clear; and their all but exclusive use of melody no more proves that harmony was unknown to the Assyrians, the Hebrews, or the Egyptians, than does the exclusive use of the lintel in Greek architecture prove that the arch was unknown to their predecessors or contemporaries. We know not much more about the orchestras of the middle ages than about the orchestras of a higher antiquity. We have ascertained, from sculpture and painting chiefly, what the mediæval instruments were to the eye, which enables us to form a very fair estimate of what they were to the ear. But how they were grouped, and what effect resulted from their grouping, are still matters for speculation. The 14th century seems to be the epoch at which musical gatherings systematically organised began to be numerous and important enough to deserve recording. One of the most remarkable was in the year 1341, when Petrarch was crowned in the Roman Capitol. At the ceremony were present two bands of musicians, the one vocal and the other instrumental, who continually sang and played "in sweet harmony" (*con dolce concento*). Boccaccio's party of ladies and gentlemen, to whose retreat from Florence during the plague in the same century we owe the Decameron, are described as continually singing and playing on different instruments. Those mentioned are the lute and the viol, on which latter several of the ladies performed, and the cembalo, probably some kind of spinet. But one of the earliest orchestras of which we have any satisfactory account, and of which the parts were expressly written for the instrument, was that employed in Peris' opera "Euridice," performed at Florence in 1600, at the marriage of Henri IV. of France and Marie de Medicis. The orchestra presents a striking contrast with those of Italian operas of the present day. It consisted of four instruments, a harpsicord, a large guitar, a viol da gamba, and a lute. Seven years later Monteverde produced his opera "Orfeo," in which he employed an orchestra of thirteen different instruments, some multiplied by two or more, so that the number of performers amounted to thirty-six. These were never all employed simultaneously, but only in groups of two or three,—on one occasion only of ten. Among the instruments are mentioned *due violini piccioli alla Francese*—possibly violins proper, but more probably kits. From this time, the beginning of the 17th century, the development of the orchestra continued, however slowly, with little intermission. In the second half of it orchestras of respectable size were formed, in France under Lulli, in Italy under Corelli, and in England under Purcell and his contemporaries. At the beginning of the last century orchestral composition and performance received a great impulse in Italy from the foundation of the School of Naples by Allessandro Scarlatti, and in Germany through the genius and industry of Bernhard Keiser, director of the opera at Hamburg. With the early days of Joseph Haydn (b. 1732) the history of pure instrumental music really begins, and from them it must be read chiefly in the lives and works of his countrymen. Among these the first place must be given to Mozart. Prodigious as the steps may be which subsequent masters—Beethoven for instance—have made in the development of the orchestra, one particular step of Mozart exceeds them in extent and in importance. In the opera "Idomeneo," produced at Munich in 1780, the modern orchestra was definitely formed, and in that work may be found, by those who know how to seek them, the principal canons by which orchestral composers have on the whole been guided for the last eighty-seven years. Great progress had been made in orchestral effects since 1780, by Mozart himself, no less than by his successors; but the progress had been in directions first taken by Mozart, and the chart of which is the score of "Idomeneo." Mr. Hullah then proceeded, aided by a diagram, to explain the compass and other peculiarities of the various instruments used in the modern orchestra, their proportions as to numbers one to another, with other particulars as to the modes in which they were used. The lecturer proceeded then to speak of those domestic substitutes for the orchestra —the pianoforte and its predecessors. The latter—the plucked keyed instruments—flourished from the 14th century down to the end of the last, in the early part of which the idea of bringing hammers to act upon strings by the key-board occurred to three ingenious artists—Marius, a Frenchman; Schröter, a German; and Cristofali, an Italian. To the latter belonged, beyond doubt, the honour, or the good luck, of having first made his invention known,—in the year 1711. Mr. Hullah then called attention to an instrument in the room, of a class of which the majority of his audience had probably met with few or no specimens. It was a harpischord (date 1623), made by the celebrated Rucker, of Antwerp, and perhaps one of the most perfect in existence. It had two rows of keys, which afforded the only variety in intensity of which it was capable. It was in consequence of this possible variety that its successor was distinguished as the piano-forte, *i.e.*, the soft or loud. In the harpsichord the string was plucked or pulled by a quill, and unless the key which acted on it was struck very decidedly it produced no sound, while a too hard blow produced no more, but would make a disagreeable rattling. Mr. Hullah then further explained the mechanism of the instrument, the quality of which would appear to those who had never heard it before somewhat thin and wiry; but, perhaps, after listening to it for a few moments they would find that, however inferior in some respects it might be to the pianoforte, it was not without a charm of its own. The lecturer then played a movement from a fantasia by C. P. Emanuel Bach, a gavotte by Padre Martini, and Handel's "Harmonious Blacksmith;" concluding, at the request of the chairman, with "God Save the Queen."

The Chairman (Mr HAWES), said that as this was the last lecture of a course which he believed had given especial pleasure to a numerous audience, he thought they would be glad that he should take this opportunity of thanking Mr. Hullah for the valuable information he had conveyed to them, in a most agreeable form. The art of music was one that now excited so general an interest, and was so widely cultivated, that he thought the favourable manner in which these lectures had been received would probably induce the Council to take up,

in future sessions, this and other subjects which were not only interesting to the members themselves, but also to the ladies, who, he was happy to see, formed an unusually large proportion of the audience during the course just concluded.

Twenty-first Ordinary Meeting.

Wednesday, May 8th, 1867; John MacGregor, Esq., in the Chair.

The following candidate was proposed for election as a member of the Society:—

Davidson, James, Laboratory Department, Royal Arsenal, Woolwich, S.E.

The following candidates were balloted for, and duly elected members of the Society:—

Ainslie, Montague, Grizedale, Hawkshead, Windermere.
Amhurst, W. Amhurst T., Didlington-hall, Brandon, Norfolk.
Essell, George, The Precincts, Rochester.
Fisher, Thomas, 24, Hanway-street, W.
Hutton, Thomas Winder, 5 and 6, Newgate-street, E.C.
Maddick, Alfred, 40, Clarges-street, Piccadilly, W.
Rylands, Peter, Bewsey-house, Warrington.
Sayer, Commander George, R.N., Statenborough-house, Sandwich.
Tinne, John A., F.R.G.S., Brierley, Aigburth, near Liverpool.
Toler, Hon. Ottway Fortisque, 6, Albemarle-street, W.
Weld-Blundell, T., Ince-Blundell-hall, Great Crosby, Liverpool.

The Paper read was—

RECENT INVENTIONS IN MILITARY BREECH-LOADING SMALL ARMS IN EUROPE AND AMERICA, PARTICULARLY IN THE UNITED KINGDOM AND THE UNITED STATES.

By Capt. O'Hea, late 25th Regt., K.O.B.

By the term "recent inventions," I mean to convey that, as far as it is possible for the explanation of such a subject, it is my intention to confine my remarks this evening chiefly to fire-arms invented within the past seven or eight years. It is a proverb that, "Beneath the sun there is nothing new," and this, in a particular manner, appears to apply to breech-loading fire-arms, as we find in the armories of the Tower of London and of Woolwich breech or chamber-loading and repeating guns bearing dates as far back as the middle of the sixteenth century; but I shall leave to the curious in such matters the enjoyment of a dive into rusty antiquity for complex and cumbrous inventions of past ages, and, with your permission, proceed to discuss the ingeniously-contrived, smoothly-working, and more deadly weapon of the present day.

To enable you to understand more easily the principal advantages and mechanism of the several breech-loading arms which I shall have the honour to bring to your notice this evening, it is necessary that I should preface my paper with some remarks on the cartridges suited to, and in use with, the arms. The metallic cartridge is the one to which, in particular, I wish to ask your attention; indeed, the invention of paramount value, appears to me to be this cartridge, for the arms can only be remarkable as very ingenious pieces of machinery for carrying out that invention.

A cartridge containing its own ignition is by no means a recent discovery, for, in 1831, Monsieur Robert invented or patented such a cartridge, and in 1836 a Parisian, named Lefaucheux, introduced the metallic cartridge at present, with various modifications, in general use, with smooth-bore sporting arms, and which answers well the purpose for which it is intended.

The cartridge for the Prussian needle-gun, which, although not metallic, contains its own ignition, has been in use in the Prussian service many years. But the metallic cartridge for weapons of war was first largely adopted by the Federal army during the late civil war in America, and was the parent of many beautiful inventions in breech-loading small-arms. There cannot, I think, be a doubt but that to the adoption of this cartridge and the weapons it called forth, may, in a good measure, be attributed the closing of the great civil war of modern times, and the terminating of vast sacrifices of human life and of treasure.

For the purpose of explaining the important connection of the cartridge with the breech-loader of the present day, I will select for description from the many kinds now in use, four—

1st. According to date of invention or patent, is the rim fire copper-cased cartridge in general use in the United States for the past seven years.

2nd. The Boxer cartridge, recently adopted in our own service for use with the Snider breech-loading rifle.

3rd. The Chassepot cartridge, adopted in the French service for use with the Chassepot gun.

4th. The cartridge recently invented by Mr. Daw, of Threadneedle-street.

The first-named (American) is a simple metallic cartridge, consisting of four parts, viz., the shell, the fulminate, the charge of gunpowder, and the bullet. The shell is formed of one description, and from one piece of soft metal (copper),—is without joining or welding of any kind, being punched, or plugged out from the solid metal by machinery, and is as nearly as possible of equal substance or thickness throughout for the purpose of equal expansion. The means of ignition is in the shell, round the rim at the base, and, when loaded with the charge of gunpowder, this shell is made to grip the projectile, so as to unite it with the gunpowder and fulminate in one compact body. The projectile is solid, and composed altogether of lead. In addition to the small number of its component parts, this cartridge has much to recommend it. It is impervious to moisture, and may even be used after immersion in water. It is gas-tight, for the shell, expanding with the combustion of the charge, combined with the resistance offered by the initial movement of the bullet, completely seals the breech, and thus effectually prevents gas escape breechwards. It has the additional advantage that the copper shell can be re-formed and re-loaded after the contents have been discharged. A very portable and simple machine for this purpose is in use in the United States. I see that an instrument for closing and re-priming cartridge cases was patented in England on the 17th April, 1867, by a Mr. Thomas Horsby.

The original shape of this (the American) cartridge case was cylindrical, with a projection at the base for the fulminate, and to help the extraction of the expanded shell, but some modifications have been brought into use with particular arms, the one most highly spoken of being that of General Roberts, of the United States regular army. The peculiarity of this cartridge is that the cylindrical portion of it, which is larger than the bore of the arm, extends into the barrel but a short distance, when the diameter of the chamber, as well as of the shell, lessens slightly until the latter joins the bullet. The inventor informed me that this greatly facilitates the extraction of the expanded shell, causes more even expansion, and enables the cartridge to contain a somewhat increased charge of gunpowder, which latter is a great recommendation to General Roberts's cartridge, as the defect in all American cartridges is the want of a sufficient charge. I have seldom seen in the United States a charge of powder containing more than 45 or 50 grains used in metallic cartridges for an arm of 45 or 50 calibre, to propel from 350 to 450 grains of lead, and with this charge the trajectory, or course of the bullet,

is high and the shooting uncertain at ranges exceeding 500 yards.

The Peabody, Cochran, and Hammond rifles are the only American breech-loaders I have seen using a metallic cartridge with a charge of 55 or 60 grains of powder. However, this fault in the American cartridge could easily be rectified. Another peculiarity of American arms using the metallic cartridge I would mention here. The diameter across the base of the projectile used is always greater than that of the bore of the rifle, measuring from land to land or the raised portion of the rifling. Polygonal rifles, such as the Whitworth, are not used in the United States, consequently the bullet is forced to take the grooving as it passes through the barrel. This has its advantages. It is impossible the bullet can strip, avoid taking, or leaving the grooves; and I have seldom heard of fractures.

The second description of cartridge, the Boxer, is known to you all. I will call it a compound metallic, for, though, like the first-named (American cartridge), it consists of but four parts, viz., the shell, the fulminate, the charge of gunpowder, and the projectile, two of those parts are compound in themselves. The shell, or cartridge-case, is of two distinct kinds of metal, brass and copper, and in three distinct parts, namely, the base, the coil shell, and the cap for fulminate, and the projectile is composed of lead, wood, and clay, wood for the centre of the bullet and clay for the expanding plug. The cylindrical portion of the cartridge-case is formed of a little over two turns of very thin sheet brass, which is supposed to be expanded, or rather slightly uncoiled, by the explosion, thereby avoiding the danger of fracture of metal by expansion, and of consequent gas escape, even though the cartridge be used in a chamber somewhat larger than its diameter. The base of the cartridge-case is also of brass, but of much greater substance than the cylindrical portion of it, to which it is welded or soldered, and it has a projection to stop its entering too far into the barrel, as well as to facilitate its extraction.

In the centre of this base-piece is fixed a cap of copper, which contains the means of igniting the charge, and from which the cartridge derives the title, central fire.

For the purpose of retaining in the new projectile (although decreased in weight by 50 grains), the length and figure of the old, as also with a view to place the greater weight as far as possible from the centre of rotation, the bullet has a picket of wood running through its centre, halfway from the apex of the cone towards the base. At the base is a cavity, containing an expanding plug of baked earth, which latter is also intended as a support to the sides after expansion.

As was a necessity with the old muzzle-loading arm, the bullet for the present breech-loader is still made smaller than the bore, and depends for expansion into the grooves on the plug of baked clay at the base. This is peculiar, and why retained I cannot say, unless the material of which the barrel is formed (soft iron) renders necessary the avoidance of forcing the bullet through the grooving, thereby causing extreme expansion. I am more disposed to conjecture this to be the cause of the size of the present bullet, from the caution inculcated regarding the care of the barrel, in the "Regulations for Conducting the Musketry Instructions of the Army," under the head "Cleaning Arms," Part IV., pp. 24 and 25. Although the cartridge-case covers the *cannelures* or grooves which contain the lubricant, it does not grip the bullet, merely holding it loosely in its place.

I am not aware that this cartridge-case can be reprimed and charged after being once used. The charge of powder is 75 grains, and the weight of 60 rounds is about 6 lbs.

It would be presumptuous in an humble individual like myself to offer any opinion of the merits and performance of the Boxer cartridge, when the report of so high an authority as the Inspector-General of Musketry is published on it. I shall therefore give you General Hay's report, than whom there is not in England one more competent to judge of the merits of a rifle or rifle projectile. The report was printed for the information of Parliament and the country on the 22nd February, 1867. It proceeds thus:—

Report of the Shooting of the Snider Breech-loading Long Rifle with the new or No. 3 pattern Cartridges, Bullet weighing 480 Grains.

Hythe, 15th February, 1867.

SIR,—In obedience to the instructions contained in your letter of the 29th ultimo, I have made a trial of the "central fire ball cartridges made up with a shorter, or 480 grains bullet, called pattern III.," with the Snider breech-loading long rifle, and have now the honour to report, for the information of His Royal Highness the Field-Marshal Commanding-in-Chief, that the shooting at 600 yards is equal to, and at 800 yards better than that of the muzzle-loading long Enfield rifle, pattern 1853, with ordinary ammunition, *vide* table as per margin. I would remark, however, that the angle of elevation with the Snider rifle is considerably greater at both distances than the Enfield rifle, pattern 1853, although the bullet is 50 grains lighter. I need hardly observe, that while the curve of the trajectory is considerably increased (a serious defect in a military arm) the penetration, owing to the decrease of momentum of bullets, must be considerably less than with the ordinary muzzle-loading ammunition. In several instances the cartridge case stuck fast, and could not be removed without the ramrod. The rifle fouled considerably, and in one or two instances there was a slight escape of gas, which did not however interfere with the working of the breech-block. I have no doubt that these defects will be easily overcome when the process of manufacture is better understood. The weather has been very unsettled, hence the delay in making the trial in question, and this report consequent thereon.—I have, &c., C. HAY, Inspector-General of Musketry.

With reference to the latter part of this report, I think it right to state that the defects in the cartridge to which the Inspector-General alludes have, I trust, been overcome in process of manufacture, as I have been lately informed, by the well known gun-maker, Mr. Field, of Holborn, that the Snider breech-loading rifle, in the trial of small arms which is at present being carried on by a special commission at Woolwich, is as yet holding an advanced position, being second or third in the competition. Mr. Field has also kindly given me several cartridge cases of this description, which have been used with the Snider breech-loader, and which, as may be seen, exhibit no trace of gas escape.

The cartridge I have named third, the Chassepot, in use with the Chassepot gun, I will designate a semi-metallic cartridge, as the face of the powder case only is protected by metal. It consists of six parts, viz., the priming, the powder case, the powder, the paste board wad, the ball case, and the ball. The priming consists of a copper cap, like the ordinary military percussion cap, but of smaller dimensions. It is formed at the bottom with two holes diametrically opposite each other, intended to give free passage to the charge of powder for the spark or flash, the fulminating powder being placed at the bottom of this cap; a small plug of cloth or wax covers it, so as to protect it from external concussion. The cap is then covered with a thin washer of brass, copper, or other metal, which is pasted upon or attached to paper, for forming the base of the cartridge, and the priming is thus complete. The powder case is formed from a rectangular piece of paper, rolled upon a mandril, and pasted at the edges. When the case is dry, the priming is inserted by a mandril, and the end of the case is then closed and pasted. The case being thus prepared, the charge of powder is inserted, and is pushed down gently to give rigidity to the car-

tridge.* A pasteboard wad is next placed on the powder, formed with a hole, into which the twisted end of the paper of the case is inserted, the excess paper being cut off. I have adopted the words of the specification.

The ball case is composed of a paper jacket having two folds of paper, pasted and closed at one end only. The ball is of an elongated tapered form, with a flange at the base. After placing the ball in its case this case is connected to the powder case by a string or thread passed round a groove on each case, a slight distance behind the wad. Finally, the cartridge is greased. The price of the cartridge is 60s. per thousand; the price of the rifle is only 70 francs.

4th. According to date of patent, I have chosen the cartridge lately invented by Mr. Daw, of Threadneedle-street, which I shall also call a compound cartridge, and which amongst recent inventions is worthy of special mention, as containing some peculiarities of novel and ingenious description. The cartridge, like the other metallic cartridges I have specified, is composed of four parts, two of which are compound. The bullet, as in the Boxer, has the wooden picket through half its longer axis, and the clay plug in the base for expansion. The shell is also of brass, and in three parts, retaining the copper cap for the fulminate in the centre of the base.

In almost all other respects this cartridge differs materially from the others I have mentioned. It is much shorter than the present service cartridge, and the inventor consequently claims for it great facility of extraction from the regulation arm. The cylindrical portion of the case is composed of a little over one fold of thin metal, which being united is perfectly gas-tight, and, from the slightness of this one fold, of little or no weight, and of great flexibility and toughness. The latter is a marked advantage over stouter metal, as the case, on the ignition of the charge, cannot fail to take the form of the breech or chamber in which it is enclosed, and cannot impede in the least the extraction of the shell after explosion, as the sudden alteration of temperature after the gas leaves the barrel causes a slight contraction of the metallic shell. Mr. Daw informs me that when the breech-block is open, without using the extractor, the cartridge-case can be removed by a puff down the barrel from the muzzle. It is water-proof as well as gas-tight, requiring no paper covering or lubrication, as, in addition to the shell being joined by cement or solder, it grips the bullet closely above the *cannelures* or grooves, and thus the projectile, with the powder and fulminate, are held together in one compact body by the slight shell. The weight of sixty rounds of this cartridge is 5 lbs. 11 oz., the weight of bullet 465 grains, that of shell and fulminate 105 grains, and the charge of gunpowder is 65 grains. I am informed by Mr. Daw, the patentee, that the cost of this ammunition is £4 5s. per thousand.

Besides those I have selected for explanation, there are various other descriptions of metallic and semi-metallic cartridges, each possessing some peculiarity to recommend it. Amongst the American inventions are the Spencer, Peabody, Ball and Lamson's, the Henry, the Cochran, and a multiplicity of others, for our relatives at the other side of the Atlantic appear of late years to have turned their inventive genius in this direction; but, as I have already stated, the propellent force is deficient in all, save a few, for accuracy at ranges beyond 500 yards; the Americans being under the belief, and with good reason, derived from sad experience and actual practice in the field, that rapid fire at short range, when there is little chance of missing the object fired at by troops but partially trained to steadiness in the ranks, is the essential for military, or rather militia and volunteers employed against an enemy.

Of English cartridges there are not such a variety. The same necessity for such inventions, we are thankful to say, has not existed for calling on English inventive talent. There is one, however, recently invented cartridge, or rather cartridge-case (for I regret to say I have not been able to inspect the projectile used with it, or the charged cartridge), which deserves particular mention, not only as a clever contrivance to suit a particular arm, but as a departure from the fashion and manufacture of cartridge-cases in brass, folded or punched metallic substance. The inventor is Captain Selwyn, R.N.

You will easily perceive, then, the important part the metallic cartridge has to perform with the breech-loading arm of the present day, acting as it does as an expansive metallic chamber, containing the charge inside the bore, and only requiring a support of sufficient strength to keep it from moving, to ensure its being a perfect check to gas escape breech-wards.

Before closing this part of my paper there are a few suggestions which I would venture to offer on the system of metallic cartridges in general, acquired from some little practical experience.

In the metallic cartridge there appear to me, in addition to the great essential of a sufficient charge of gunpowder for the diameter and length of bore and weight of projectile, five other requisites for ensuring a favourable result or return in the use of the metallic cartridge.

1. That the shell or case be of metal, of such description or substance as will ensure its expanding or contracting, but not fracturing.

2. That the shell be formed of one piece if of soft metal, and of one fold if of harder or medium metal, and that it be gas-tight, limited as to power of, and space for expansion.

3. That the expansion of different metals being unequal, the insertion in any part of the shell of any foreign piece of metal, or even of a distinct piece of metal of the same kind, be avoided, as tending to weaken or fracture it and increase the cost of manufacture; the fulminate ought also to be placed somewhere on the inner surface at the base of the shell, no matter how that surface may be modelled.

4. That the shell grip the bullet so that the cartridge may be impervious to moisture, and that the expansion of the shell may be compulsory or inevitable on the expulsion of the bullet.

5. That the base of the projectile be of such a diameter that it is not only forced to take the grooves as it enters the rifled portion of the barrel, but that all chance of gas escape round the bullet is impossible, and that the latter contain no foreign substance or body that would make it liable to fracture on being driven into the bore, or make the manufacture of it complicated or difficult under any circumstances.

The advantages of central fire over rim ignition which, in theory, are no doubt maintainable, are not found so in practice, at all events at medium or short ranges, to be appreciated, at least at a range where military fire in line would be effective. When it it is considered that central fire cartridges, having conical or pointed projectiles, cannot be used with the magazine arms at present known or in use, without positive danger to the person using the arm, and to all standing near him, I am sure you will agree with me in thinking that any theoretical or other advantage the former may possess does not give it equality with the rim-fire metallic cartridge.

I now turn to remark upon the arms suited to the use of the metallic cartridges, which I have endeavoured, however imperfectly, to place before you. My object is not to speak of the barrel of the rifle, but I may mention incidentally one or two points, which may not be generally known to ordinary observers, first reminding you that the chief properties of a good fire arm are power, accuracy, and rapidity of loading.

The accuracy of an arm mainly depends on the finish of the bore, and the weight and quality of the metal of the barrel. The greatest accuracy is attained at short and medium ranges, and when the influence of

* This is peculiar, and in the English school would be considered equivalent to loss of range.

the wind and of the atmosphere are but slightly felt, by rifles having equal expansion throughout the barrel—the most perfect barrels being manufactured of metal of equal quality, and having a thickness of such metal all through from breech to muzzle equal to the diameter of the bore. As all reductions of this weight, or lightening of the metal towards the muzzle, unless compensated for by a continued and gradual alteration of the quality of the metal throughout the barrel (which I conceive to be an impossibility), must be at the expense of accuracy, no such certain results can even be attained from a barrel sufficiently light at the muzzle for use with troops.

Upon the quality, and the quantity, to a certain extent, of powder used, depends power. I will, therefore, assume for the present that all small arms are equal in force and accuracy, as they may be made if they are not, and will turn to explain the mechanism of the frame, and the appliances for loading and closing the breech of several fire-arms suited to the use of the metallic cartridges in the foregoing varieties.

To the observant soldier or civilian, acquainted with the use of fire arms and interested in military or other arming, it has long been evident that, not only does the question of efficiency and military success depend upon the end of the barrel which receives the charge, but also upon the use of that arm which can be loaded with the least difficulty and in the shortest space of time.

Assuming, then, that time spent in changing fire arms is time lost, it follows that if we could be so fortunate as to get hold of an arm of simple and durable construction that would require no time to load—in fact, which after each discharge would be found ready loaded for another, leaving all time to aim and fire, we should have a perfect, in fact a magic weapon. Such an arm not being forthcoming in the present day the next best would be the one requiring the least time to load, of course everything else being equal, simplicity of construction, durability, finish, and all other essentials.

That arm which requires the fewest and simplest movements to load it, can be charged in the shortest space of time, but, as we are all instructed, and know well, that aim, to be effective, cannot be limited as to time, leaving the sharp-eyed or quick-fingered volunteer, or the more slow and well-trained regular to fire in his own good time with a snap shot or rising aim, I shall now endeavour to place before you several descriptions of breech-loading small arms, which, for convenience in explanation, I propose to divide into three classes:—

1. Single-loading arms, or breech-loaders simple.
2. Repeating breech-loaders, or magazine arms.
3. Single-loading and repeating arms combined, or compound breech-loaders.

By the first division I mean breech-loaders in which the barrel is charged by hand from the ammunition or expense pouch of the soldier round by round of ammunition. By the second I mean arms containing a magazine from which ammunition, to a certain extent, is supplied to the barrel round by round by mechanical means, and which when exhausted is replenished by the soldier's supply in his pouch. The third division is a combination of the first and second, being a single-loading arm having a magazine in reserve.

Of the first division—single-loading arms or breech-loaders simple—I have some here of English and American manufacture, as also the French arm, the *Chassepot*.

It would be difficult to make a selection from so much that is excellent, were it not necessary that I should follow to some extent the classification I have adopted in the explanation of the cartridges. I will therefore first attract your attention to those single-loading arms suited to the use of the four descriptions of cartridges I have chosen, and afterwards shall be happy to give any explanation in my power regarding others which have been entrusted to me.

The Peabody rifle will worthily represent a single-loading arm, using the copper-cased rim-igniting cartridge. It is Yankee in the fullest sense, being a Massachussetts invention, and bearing a name justly honoured in this great city. It is a very simple arm, as you will see, and I understand most effective. Exclusive of the frame, the breech-loading appliances consist of four parts and five pivots. The means of extracting the charged cartridge, or empty shell after explosion, is the simplest and most perfect I have ever seen. It is effected by the action of an elbow lever, which throws it out with unerring certainty the instant the trigger-guard is lowered; and this lever derives its power from the action of the breech-block itself, and cannot become deranged, as it is not dependent upon any springs, and is of such strength as to prevent the possibility of breakage or derangement by any service to which it can be exposed. The rifle cannot be discharged until the breech-block is in its proper position, and when not loaded it cannot be injured in the least by being snapped. It has been reported on by the board of officers appointed by the United States War Department for inspecting small-arms, as being "undeniably the best for the use of troops," their duty being only with reference to an arm for military purposes.

This arm can be loaded in two simple movements, the extractor doing the duty of another motion, as follows:—

1. With the thumb of the right hand close down the guard lever with some force, and the cartridge or shell in the barrel will be immediately thrown out. Carry the hand to the pouch, and take hold of a cartridge with the forefinger and thumb.

2. Place the cartridge into the barrel, pushing it home with the thumb. Close the breech, and the gun is ready to fire, on being cocked.

You are no doubt aware that for this description of cartridge rim-fire the exploding bar, or striker, must be somewhat at one side, not in the centre of the breech-block. The weight of the Peabody long rifle is something less than our regulation arm, its calibre ·50. The charge of powder is sixty grains, and the weight of ball is 425 gains.

I have here other varieties of single loading arms adapted to the use of the rim-fire copper cartridge, all of which are American inventions, such as the Cochran, the Jocelyn, and the Hammond.

The Hammond breech-loading rifle, which I received for inspection a few days since, is a novel description of American single loader, and relates to that class of fire-arm in which a solid swinging breech-block is used to open and close the cartridge chamber, and, at the same time, to act on the ejector.

The invention consists, firstly, in making that part of the frame against which this rear portion works of an eccentric form, so that when the breech-block is swung to the left, it will have a lateral and oblique rearward movement, for the purpose of opening the cartridge chamber, and when swung to the right shall have a lateral oblique forward motion to close the cartridge chamber.

The inventor claims for this arm that it has no weak parts, is not liable to get out of order, and may with safety be placed in the hands of raw recruits.

In the limited space of my paper it would be impossible to give a full and detailed description of this or any of the arms I have here, but in this particular one there are a few peculiarities of merit to which I think I ought to attract your attention, viz., that the hammer is made to serve, at the time of firing, to lock or key firmly together the frame and breech-block; also, that it is impossible for it to be snapped until the breech-block is in its place. I have only seen one other American rifle in which a somewhat similar appliance has been adopted, namely, Weasons' patent. I am informed that Mr. Daw has fired this arm, at a trial at Chislehurst, with deliberate aim, ten times in fifty-seven seconds, making at a hundred yards three bulls'-eyes and hitting every round. The weight of the American rim fire cartridge for the Hammond arm is 527 grains. Copper case, not quite 90 grains; ball, 378 grains; powder, 59 grains. Mr. Daw

has converted this rifle into a central fire arm to suit his cartridge, altering the charge of powder to 56 grains.

The representative of the inventor of the Hammond rifle is present this evening, and he or Mr. Daw will give more particular information on the arm, should it be required, during or at the close of the discussion.

The arm for which the second description of cartridge was invented, is the Enfield rifle converted to a breech-loader on the Snider system. Regarding the practice with this arm, I refer to the official report of the Inspector-General of Musketry, already given. To load the Snider two movements are necessary, one of which is compound, having several motions under the head of one order, namely that part of the movement detailed at "Three" of the order "Present," and commencing—"Half cock—open the breech—and, holding the breech-block firmly with the forefinger and thumb, by means of the thumb-piece and nipple-lump, draw it back as far as possible by a jerk, raising the muzzle of the rifle slightly in doing so, to remove the empty cartridge-case; at the same time cant the rifle sharply over to the right, to allow the case to fall out, bringing it again to the horizontal position; then, carry the right hand to the pouch, and take hold of a cartridge at the rim with the forefinger and thumb" (*vide* "Platoon Exercise" for long and short Snider breech-loading rifle). Though this arm may not be as perfect in all respects as some original inventions, it ought to be remembered that it is a convert, and, taking everything into consideration, it is a good arm, and much has been made of the old material. I have seen a few other arms altered to suit the central fire cartridge. I may mention one, the Mayall, which, by the kindness of Mr. Crane, gun-maker, I have been enabled to examine, and which appears a capital conversion.

Of the Chassepot gun, using the Chassepot cartridge, I can say but little from my own experience; it is a needle gun, and the invention consists mainly in the contrivance adopted for preventing the escape of gas breechwards. The hermetic closing of the breech parts is obtained by the instantaneous compression, under the action of the explosion, of a vulcanised caoutchouc washer interposed between the front face of the breech-bolt and a flange, or shoulder, upon the needle-guide, which guide is marble. The washer and the flange, or shoulder, are of a little less diameter than the breech in which they are fitted, so as to facilitate their play therein, but the diameter of the front face of the breech bolt is as nearly as possible equal to the inner diameter of the breech. When the explosion takes place, the pressure transmitted by the movable needle-guide to the washer is such that the latter is compressed sufficiently to hermetically close the rear end of the barrel, and thereby prevent all gas escape. (Those who have noticed Thompson's patent stoppers, used by Messrs. Crosse and Blackwell for their pickle bottles or jars, will at once understand how this is effected.) After the charge is fired and the pressure removed, the washer, by virtue of its elasticity, returns to its natural position. The washer is composed of three layers, one over the other, intimately united, and having different degrees of hardness, viz., the two outward layers are of much harder substance than the centre one, so that, on being pressed, the intermediate layer, which is perfectly elastic, expands. The mechanism of the breech consists of seven parts. Any central-fire breech-loader can use Mr. Daw's cartridge.

Of the second class of arms, repeaters, I have here two good specimens, of the performance of which, in actual practice against an enemy, I can speak from some experience, having been in the United States during the latter part of the civil war. The Spencer is a repeater of seven rounds, having the magazine in the stock, between the heel-plate and the breech, which magazine is composed of a double sheathing of metal strongly incased in the wood, and thus presents as formidable an obstacle against external force as does the barrel itself. It is asserted that the cartridges in the magazine of the Spencer are, if possible, less liable to premature explosion than is a single cartridge of the ordinary kind in the barrel of a muzzle loading arm. There are, however, with all its merits, like everything in this world, two or three weaknesses in the Spencer which I should wish to point out. The magazine spring being a detached, part is liable to be lost when loading the magazine, the extractor, which levers out the shell of the cartridge, may be bent or broken, and the cartridge in travelling from the magazine to the chamber sometimes jams; but I am informed that two of these three little blemishes are about to be corrected in this most efficient arm. The barrel of the Spencer can be charged from the magazine by the lowering and rising of the guard-lever, another motion being required to cock. The weight of this arm is 10 lbs., the charge of powder is forty-five grains, and the weight of the ball 400 grains.

The other arm of this class which I have here, the American Henry, has a magazine of fifteen rounds, which is situated beneath the barrel and parallel with the bore. The magazine can be filled in thirty seconds, and it is asserted that the gun can be fired from the shoulder fifteen times in ten seconds. The charge of powder is 25 grains, and the weight of ball is 216 grains. The great objection in this arm, namely, the magazine being exposed and the necessity of loading it from that end next the muzzle, has been removed in the improved arm, the Winchester Henry. By lowering and raising the guard lever the barrel of this arm is charged with a cartridge, the cock at the same time being placed at full bent, by which one motion is saved.

Of the third division, compound breech-loaders, there are two here for examination—Ball and Lamson's repeating and single-loading carbine, and the Spencer already named, converted into a compound breech-loader. At the commencement of this paper, I quoted the proverb, with reference to fire-arms, that "there was nothing new beneath the sun," but the first-named arm is the exception to prove the rule, for I have never read or heard of an invention with such power. It combines all the advantages of a single-loading gun and a repeater, being used for either with equal facility. It may be fired as a repeater nine times in eleven seconds, and as a single-loader twenty-five times per minute, so the inventor asserts, and Mr. Lamson has informed me personally of the same. The magazine full of cartridges may be held in reserve for any sudden emergency while using the arm as a single-loader. It may also be emptied of cartridges without firing or detaching any of the parts. If one or more cartridges should be put in the magazine wrong end first, on working the lever every wrong cartridge will be thrown out by the ejector, without interfering with the working of the gun, or causing the removal of any part of it. There can be no explosion of the magazine, as this is securely closed whenever a cartridge enters the barrel; it is entirely covered and protected from accidents. The weight of the carbine is only $7\frac{1}{2}$ lbs., the calibre is ·50, the length of the barrel is 22 inches, the charge of powder 45 grains, and the weight of bullet 350 grains.

This little arm is an American monitor on a small scale, for it admonishes you when it is loaded, as you cannot open the breech when there is a cartridge in the barrel without going through the motions of firing, that is, drawing the cock to full bent, and letting it down again on its bearings, the breech being locked whilst the arm is at half or full cock. It has one other peculiarity I would mention, there is no danger of the fixing from rust nor other causes of either pin or striker, as neither one or the other is required, the charge being ignited by a blow on the cartridge case direct from the hammer.

I have often heard repeating arms objected to, on the score that the supply in the magazine would be wasted by the soldier. When looking back at the register of the practice, to use a musketry term, on human targets,

of troops but partially disciplined that were armed with this description of weapon, during the late civil war in America, we cannot help looking on this objection as premature. Experience proves that, in the only war where these arms have been tested, the great superiority and advantage the soldier had over the enemy arose from the fact that his having such a weapon in his hand gave him confidence and self-possession, so that the chance of waste of ammunition through excitement was actually diminished.

I will conclude by thanking this assembly for having so patiently listened to my somewhat lengthy paper this evening, which, as can be perceived, has been hastily written; and I trust they will deal lightly, both in thought and word, with its many defects, and any peculiarity of opinion which I may have ventured to intimate.

DISCUSSION.

Mr. NURSEY introduced to the notice of the meeting a specimen of the improved Spencer rifle, to which allusion had been made in the paper, and explained its mechanism. He said that the ordinary Spencer arm could only be used as a magazine rifle. He should not, perhaps, say solely as a magazine gun, because it had been used in America as a single breech-loader, by the magazine being shut off by a piece of string tied tightly to the guard lever, which prevented the magazine being opened; but there was this fault in the original arm, that if the extractor was not very nicely regulated, the cartridge shell jammed, and could not be easily extracted. Mr. Nursey stated that the main peculiarity in the arm was this: the action of the stop consisted in crossing the jaws of the double cartridge guide, which then stopped the breech-block from descending beyond a certain point by coming up against the extractor. Some trials had lately taken place with this rifle in France. In an official trial which took place recently, the firing commenced at 200 metres, and was carried on successively at 400, 600, 700, and finally at 750 metres. Bull's-eyes were repeatedly made by officers who had never fired the gun before. After the practice at 750 metres, the party moved up to 200 metres for the purpose of testing the gun at rapid firing. At this point forty-two shots were fired in two minutes, when the firing was momentarily interrupted owing to the barrel becoming too hot to be held with the naked hand. A thick glove was put on, and thirty more shots were fired at the same rate. As a single-fire gun many shots were fired with great rapidity.

Capt. SELWYN, R.N., said that it was generally allowed that in proportion as perfection in destructive agencies was arrived at, war would become impossible, and it was with that view they studied the question of the best mode of sending projectiles through the air which would destroy life to the greatest extent; although that must be looked upon as a rosewater mode of warfare compared with what had been proposed to be effected by chemical means, as described in a paragraph recently published in the *Standard* and other papers. We were, however, slowly and painfully elaborating the means of firing the greatest number of effective shots against an enemy in the shortest time; but it would be impossible to judge correctly of the merits of the different weapons submitted to them, unless they first of all considered the question—what was a sufficient projectile? The weight of bullet which had been decided to be effective was that which was capable of breaking a horse's leg at 500 yards, and this was found to be 520 grains. Such a bullet ought to be projected to a range 1,000 yards without too high a trajectory. It was well known that a low trajectory was of enormous value in a military weapon. If they took a charge of 50 grains of powder and fired a 520-grain bullet at 1,000 yards, they would have to point the gun almost to the sky. If, on the other hand, the weight of the bullet was diminished, it would not break a horse's leg at 500 yards; therefore they must adhere to the heavy bullet, and this involved a great amount of propulsive force. The propulsive force generally used with this weight of ball was 70 grains of powder, which was considered sufficient to give satisfactory effects at 1,000 yards. The first attempts with the French rifle were made with 386 grain bullets and 55 grains charge of powder, and the results were, as reported, that "the trajectory was anywhere, and the range nowhere;" thereupon the charge had necessarily been increased, and the weight which the soldier had to carry was something like 6 lbs. for 60 cartridges, or 10 to the pound. Out of that the bullet was 520 or 530 grains, and the powder charge 70 grains; and by no device could they materially reduce the weight of the cartridge if they adhered to the weight of ball he had referred to. If they diminished the weight of the cartridge-box or powder they could only do so to the extent of four or five grains, but if they took only a small piece of the lead there was a sensible reduction in the weight; but they could not do this consistently with efficiency. With regard to any magazine gun, it was only fair, in estimating the rapidity of firing, that the time occupied in filling the magazine should be taken into account; and, moreover, if the gun would not bear the full powder charge, it could only be regarded as a cavalry arm. If there was such a combination of springs and levers that the ordinary soldier could not manage the weapon, it became objectionable on that ground. He urged the meeting not to be run away with by a pretty toy, produced at the expense of simplicity. Neither the storm sands of the East, nor the salt water of the ocean, spared the most ingeniously-contrived springs and levers. Simplicity was the main point. He did not desire to speak of any particular invention, but only on the ground of principles involved in the question; and one most important point was with regard to the construction of the cartridge. They knew very well that at two miles distance an ammunition waggon afforded a target sufficiently large for any rifled field gun to fire a shot into it with certainty, and under these circumstances, if the ammunition was of a character which could be blown up, the resources of an army would disappear from the field before they could be called forth. That it was which led the American Government to decide that they must have metallic cartridges. As to what had been done in the way of metallic cartridges in this country, the Boxer cartridge was described in the paper as consisting of four parts only: he could tell them it consisted of no fewer than fourteen different parts, and of those fourteen parts only about six were absolutely necessary. Now, what did those parts consist of? They were a fold of sheet brass and a base of sheet brass. The original invention consisted principally of these, but, when that sheet brass was tried, it was found that there was expansion at the base, sometimes owing to the thinness of the metal, and sometimes extraction was impossible, therefore a solid piece of brass was added, 74 grains being the total weight of the cartridge. It had, therefore, been necessary to reduce the weight of the bullet at the expense of the utility of the weapon, and the secret of the conflicting reports made to the House of Commons on the efficiency of this cartridge was that in no instance had the same kind of cartridge been used—the powder and bullet charge were constantly varied. Captain O'Hea's very able paper had been one of the first to give them really the different weights of powder charge and bullet fired in the various rifles, and that was the whole measure of the efficiency of a weapon. If it could not carry more than 55 grains of powder it would not do for long ranges; if it would not carry at a low trajectory it would not do for infantry; and if the weight of ammunition was such that a man could not carry it, they might as well not have the means of firing with rapidity. A French gun had been produced to fire a great number of shots, but what was the use of it? Two men could carry the gun but they could not carry

the ammunition. Returning to the question of magazine arms, he recognized the value of the fact that they could be made so as to act both as single loading and magazine arms, but he would ask whether they had been produced of full size for infantry, fit to carry a bayonet? [Captain O'Hea said this was so.] Then the additional weight to be carried was the charges in the magazine, and they must take that into consideration. He had been much gratified by the interesting collection of breech-loading arms which had been brought before them that evening. He had seen larger collections, but none more judiciously chosen, and it required a man who knew his business well to select from a large number the few which were worth something.

Mr. CHRISTY expressed his regret that he had not been able to bring with him a Chassepot rifle, owing to the manufacture of that arm being conducted in separate parts at different places. He believed there were only one or two of these rifles in this country at the present time.

Mr. RIGBY (of Dublin), responding to the Chairman's invitation, said, being partly concerned in the invention of the cartridge known as the Boxer cartridge, this was naturally a subject in which he took a considerable interest. There were a great many ingenious contrivances in the American arms that had been brought before them this evening; but, however much our cousins across the water had been before us with their inventions in point of time, he thought the present year was likely to reverse the relative positions of the two countries in that respect; and the competition which our Government had so wisely set on foot would, he was sure, produce a great number of weapons of nearly, if not quite, equal value. We were very apt in this country to bow down to American ingenuity, and to sneer at the talents of our native artizans. He had seen, since his arrival in London a few days ago, several models of arms, some of which had been laid before the Government, which appeared to him the perfection of simplicity, and in that respect were not inferior to any American invention whatever. If he might be allowed he would ask the permission of the Chairman to call upon the inventor to bring before the meeting a weapon which had not been alluded to in the paper, and which was remarkable for simplicity.

Mr. DINES exhibited the rifle alluded to, and explained its parts and action. In this weapon the breech end of the barrel has connected to it a tubular body, forming a continuation of the barrel, the rear end of which is prolonged, in the form of a tang or strap, to receive the breech-pin, which is screwed through the stock from the trigger-guard below. The upper part of the forward end of the tubular body is cut away to admit of a cartridge being inserted into the barrel through the opening so formed. Sliding to and fro within the body is a tubular breech-plug, closed at one end. When the arm is loaded ready for firing, the forward end of the breech-plug closes the end of the barrel. To the rear end of the breech-plug a lever is pin-jointed, the pin being left projecting about the eighth part of an inch beyond the side of the breech-plug, so as to form a stop to prevent the breech-plug being pushed too far forward when the gun is empty. The lever at this time lies in the tang of the body, and the spur, at the end of the lever, passes through the tang, and is held in its position by a catch. Within the tubular breech-plug is a plunger, sliding to and fro. Behind the plunger is a spiral spring, which presses constantly against it. The rear end of this spring bears against the fore part of the lever, so that the plunger is pressed constantly against the forward end of the breech-plug. In front of the plunger is a small projecting piece, which passes through a hole in the forward end of the breech-plug, and acts as a striker to explode a cap in the centre of the base of the cartridge. When the breech piece is drawn back, a tooth on the stem of the plunger is moved back beyond a catch, which retains it. This catch passes through a hole of its own size in the underside of the body, and likewise through a slot in the underside of the breech-plug. It is retained in its position by the spring, which presses it upwards against the body. This catch is connected to the trigger, so that the breech having been closed, the catch may be withdrawn by pulling the trigger, and the plunger thus set free to be driven forward by the spiral string to explode the cartridge. In order to withdraw the empty cartridge case after the piece has been fired, the forward end of the breech-plug carries on its opposite sides two extractors, which, when the breech is closed, pass beyond the flange on the base of the cartridge case, so that when the breech-plug is drawn back, the empty case will be drawn back with it. If it is desired to render the arm useless at any time, or to clean the barrel from end to end, it may be done by pulling the trigger well back so as to free the block from the slot in the breech-plug, when the breech-plug may be entirely withdrawn from the rifle. Mr. Dines stated that he had fired 18 rounds in 70 seconds, making six centres and four bull's-eyes at 300 yards, the first time he used it. He had no doubt he should be able to fire 20 rounds in the same time. An important feature in this weapon was that the breech-plug could be readily taken out and carried away, leaving only the barrel and stock behind; so that in case of retreat the weapon could not be used against those by whom it had been abandoned.

Mr. DAW said he first introduced the present central fire system in this country in the year 1861, and took out a patent for it. Since then he had shown its merits in various parts of the world as applied to sporting rifles. Finding that the Government were set upon having metallic cartridges, he had given his attention to that matter for some months past, and he had introduced the cartridge referred to by Captain O'Hea in his paper. This cartridge was 67 grains lighter than the present cartridge known as the Boxer. It was made of the thinnest metal it was possible to get rolled compatible with being water-proof and gas-tight. It was composed of only four parts as compared with the number used in the Woolwich cartridge, and 60 rounds weighed 5lbs. 1oz. as compared with the weight of 6lbs. 8oz. for the same number of the Woolwich cartridges. With regard to what had fallen from Mr. Rigby, he would state that he had models of cartridge-cases made, under the suggestions of that gentleman, with a coil of brass such as was now used at Woolwich. He expressed his readiness to submit his invention to any public test that might be desired, and his conviction that his plan of manufacture would be a saving to the country of many hundred thousand pounds annually.

Mr. BOTLY, having expressed his admiration of the beautiful inventions and workmanship that had been laid before the meeting, inquired whether, at the rate of firing stated to be accomplished in some instances, the heating of the barrel was not so great that it could not be held in the hand.

Capt. O'HEA replied, after a certain number of rounds the heat of the barrel would become very great, no doubt; that would be after 35 or 40 rounds, according to the thickness of the barrel and the quantity of the metal. From the Henry rifle 30 rounds only could be fired without heating to an extent that it could not be held in the hand; but that had now been entirely remedied by constructing the weapon in such a way that there was no connection between the stock and the parts which heated.

Mr. BLACKIE said, with regard to the number of bull's-eyes stated to have been made in the trials of these weapons with rapid firing, he should be glad to know whether they were made at the commencement, at the middle, or at the latter portion of the firing. As the barrel of the gun became heated in parts, the bore was not the same throughout, because the barrel not being all the same thickness of metal, the thick portion was not heated so soon as the thin, and the thin part thus

became expanded. He thought this was a question which had not been considered, and it was necessary to find out whether the expansion and contraction of the barrel did not render it desirable that the barrel should be of equal thickness of metal throughout the whole length.

Mr. KERR said that with regard to rapidity of firing, 50 rounds might be fired right off if there was sufficient strength of metal to stand it. But he apprehended this great rapidity of firing was not required.

Mr. NEWBY having given a description of the Jocelyn rifle,

Captain O'HEA, in reply upon the discussion, said, with reference to what had been stated by Captain Selwyn, he would give the calculation he made with regard to rapid fire, which he trusted would satisfy the meeting as to the efficacy of these weapons at short range. He did not pretend they were effective at long range. He supposed that troops in line would travel 75 paces in half a minute at "double quick," that would be 36 inches per pace. That was going an extreme distance for a charge. During the time the men were charging they could not fire, nor could they have skirmishers in front to cover them: so that the line which was receiving the charge would have plenty of time to deliver 15 rounds with good aim from these rifles; and if one round in 15, or even in 30, took effect, there would only be left half the number of men who commenced the charge. That was speaking of these weapons at short range.

The CHAIRMAN said he was quite sure the meeting would unite in thanking Captain O'Hea for this exceedingly interesting paper. He would not offer any observations upon it except on two very small points. One was with respect to the name which had been given to a cartridge now in common use, and which was the name of a Government officer. He thought it most unfortunate that a gentleman who from his position was called upon to judge impartially of the inventions of others should be himself an inventor, having personal interests involved which must naturally bias his judgment. The other point was one of a totally different nature. There was a commission for examining the 94 guns sent in for competition to the Government, but so many accidents had taken place in the trials of rifles—especially that lamentable one which occurred to Lord Bury—that a very useful suggestion had been made within the last few days, which would, no doubt, be carried out; that was, that inventors, who might be imagined to have confidence in their own productions, should themselves be called upon to fire the first rounds with their own weapons. He was sure that all present must feel indebted to Capain O'Hea for the very able manner in which he had treated this subject.

A vote of thanks to Captain O'Hea was then passed.

The following account of a trial of the Chassepot rifle, which recently took place before the Emperor of the French and Prince Oscar of Sweden, appeared in the *Times* of the 8th inst.:—"A battalion of the foot chasseurs of the Guard was placed at 600 yards from the mark, and the results obtained were quite extraordinary. After a period of precisely two minutes the trumpet sounded the call to cease firing. It was then found that the battalion, 500 strong, had fired 8,000 balls, of which 1,992 had struck the line of object aimed at. All the ground immediately in front of the mark was cut up by the balls in such a way as not to show a blade of grass left. The Emperor uttered an exclamation which graphically depicts the result, 'It is frightful! it is a positive massacre!' The battalion afterwards executed several times a similar exercise, but at distances increased to 1,000 yards."

Proceedings of Institutions.

HASTINGS MECHANICS' INSTITUTION.—The thirty-fourth annual report to 1st May, 1867, says that a steady, onward movement of quiet usefulness is its chief characteristic; endeavouring to lead on the members to the cultivation of an elevated taste, having in view the primary objects of the Society rather than a pandering to the popular prejudices of the hour. Although the year just passed through has been one of undue commercial depression, the Institution has not materially suffered by it. The number of members is above the average of the last five years. The classes, the lectures, the reading-room are as well frequented as formerly, or even better. Among the lectures that have been delivered during the session may be mentioned one by E. Wheeler, Esq., F.R.A.S., on "Ocean Telegraphs;" one by J. C. Savery, Esq., "Explanations of the System of Examinations in Connection with the Society of Arts;" one by Mr. W. Ransom, on "The Spirit of Philosophical Inquiry;" one by Mr. G. St. Clair, F.G.S., "Curiosities of Light;" one by the Rev. W. Barker, on "Ancient Mythologies;" one by Mr. A. H. Wood, on "Combustibles and Combustion;" one by Elihu Burritt, Esq., on "The Benevolent Associations of the Day;" one by Mr. J. Banks, on "Water Supply, Drainage, &c.;" one by Mr. W. C. Beck, on "Oliver Cromwell." The classes have been in active operation during the winter. There are now in the borough men holding high positions, who are not ashamed to own the class-room of the Institution as the basis from which their upward career commenced. There are sixty-two names on the class list. The following classes are in existence:—Senior French, junior French, arithmetic, drawing, elocution. The committee have again offered prizes for proficiency, and the following gentlemen have acted as examiners:—Mr. Stewart for French; Mr. W. Ransom for elocution; Mr. Burgess for drawing; and Mr. Banks for arithmetic. Twenty-seven volumes have been added to the library, at a cost of £5 19s. 4d., and 3,249 volumes have circulated during the year. During the year 139 numbers joined and 96 left. The present number is 398, the average number of members during the last five years being 339. The committee have again, during the past year, united with the sister Institution at St. Leonards in carrying out a regatta fête. The lecture session was also opened with joint soirées; the first half-course being opened with a soirée in the Music Hall, Hastings; the second half-course with a soirée at the Assembly Room, St. Leonards. A plan was adopted whereby any student from the classes at St. Leonards should be examined at the class examinations, but none presented themselves from that Institution. The two Societies have again held a preliminary meeting, and have decided to hold a fête on the next regatta day. The committee "regret that the members continue to evince so much apathy as regards the examinations of the Society of Arts." They would gladly receive any hints from the members which would point out a mode of bringing about a more satisfactory state of matters. The Committee, in conclusion, congratulate the members on the continued success of the Society. "They might have initiated changes that would have made the Society more attractive to the thoughtless and the gay; but such a course would not have been so conducive to the real welfare of those who are and ought to be benefited by the operations of a Society of this sort." "The object of such an institution as this" (say the Committee), "should be the spread of education. To help the self-educating is the honourable aim of the institution." The balance-sheet shows that the receipts have been £238 1s. 2d.; that the expenditure has been £171 15s. 3d.; that there is a balance in hand of £66 5s. 11d.; and that the liabilities are *nil*.

PARIS EXHIBITION.

The beautiful weather which has prevailed since April has produced an extraordinary change in the Champ de Mars; the trees, shrubs, and grass are begining to create something like harmony in the heterogeneous composition of the park, and the horticultural garden is rapidly developing its beauties; in another fortnight both (but especially the latter) will be delightful. The remaining unarranged portions of the Exhibition, within doors and without, are being got into order, some of them rather too gradually, and the amount and variety of the objects exposed are positively embarrassing.

Amongst the important additions made to the collection within doors during the last fortnight is that of the History of Labour, or Retrospective Museum, and although not complete it contains a most magnificent collection. The French portion is, of course, infinitely larger than that of any other country, and is admirably arranged; and there is this great advantage as regards the whole gallery—there is ample room between the cases, and the light is excellent. The French Commission is enabled to illustrate each epoch, from the age of bone and flint to the eighteenth century, very completely, and it is the first time that a great systematic exhibition of the kind has taken place; former retrospective collections have been crowded with beautiful or extraordinary productions, but this one represents very fairly the rise, progress, decline, *renaissance*, and many of the accidents in the history of handywork, and is thus an admirable school for the student in art-manufacture, while it indicates in a curious manner the tendencies and characteristics of the various ages.

Recent discoveries and discussions have given a special interest to the illustrations of the early ages of civilization; and the collection of bone, flint, and bronze arms and implements is remarkably fine. This applies not only to the French, but to every other department. Switzerland, for instance, contributes a choice collection from the lake-dwellings, with other antiquities of the kind.

There is, as yet, no catalogue of any division but that of England; the Danish catalogue as well as the Russian are nearly, if not quite, ready, but the French will take some weeks yet to prepare. Fortunately, the absence of catalogues is not a serious matter; special articles are generally labelled, and the great series tell their own tale.

The French department will be tolerably rich in all the grand divisions of decorative manufacture; the title, history of labour, is a misnomer; it should have been history of decorative art, for, with the exception of Prussia, there is no attempt to illustrate the history of any of the usual arts; in the early epochs there will be found some very curious specimens of pottery casts and bronze figures; the collection of enamels is remarkably fine, so is that of faïences; and that of china will be so when the two last rooms are arranged, which will only occupy a few days; the goldsmiths' art is fully represented in every epoch, and forms, altogether, a magnificent collection; this, of all other classes and other objects in the collection, presents the longest historical series. Denmark, Sweden, and Norway have highly interesting collections of a totally different type, and presenting more novelty to the great majority of visitors; old arms, breech-loaders, of the 15th and 16th centuries, and a small rifled cannon will attract great attention; Sclavonic art is generally well illustrated.

Holland and Belgium, Spain, Portugal, and Italy, have not yet opened their doors to the public, but the last-named will present a very beautiful collection of bronzes and terra-cotta, amongst other items.

Prussia exhibits no decorative art, but a most complete series of ploughs, from the earliest forms to those of the present day, by Dr. L. Rau. The models number nearly two hundred, and are perfectly executed.

The Russian court contains a highly-interesting collection, admirably arranged. It consists principally of old bronze work, jewellery, ancient arms and armour, curious plate, and some reproductions in plaster of the curious wood and stone carving of the Cathedral of St. Demetrius, and the churches of Saint John and Saint Isidore, at Rostov.

The British division completes the series worthily. It includes a small but choice collection of Celtic and Saxon ornaments, croziers, &c.; a series of casques of the most curious antique forms, with a few fine bits of armour; some magnificent chased, engraved, and jewelled gold, silver, and gilt work, including two silver tables, an immense silver looking-glass frame, and some noble specimens of plate sent by Her Majesty; some beautiful enamelled and chased work of the 14th and 15th centuries, English and Irish, and some fine examples of later date; some good specimens of Wedgwood, Chelsea, Derby, and Worcester ware, and other rare pieces of light-coloured Fulham stone ware. There is also a most curious exhibition of lace, selected from the collections of Mrs. Hailstone and the Nottingham School of Art, ranging from 1589 to 1800, and filling fourteen frames; and a very remarkable set of specimens of calico printing, ranging from 1760 to 1790, by the firm of Messrs. W. Bedford and Co., who were succeeded in their business by Messrs. Liddiard, and are now represented by Messrs. W. G. Cooper and Co.

Some manuscripts and other articles from the British Museum will complete the collection, which has been got together and arranged by Mr. George Wallis, upon whom it reflects great credit.

There is also a supplementary collection, which has already attracted the attention of all the foreign architects and artists, namely, a collection of photographs, with a few actual specimens of the marvellous architecture and ornamentation so little known to Englishmen, and, as a French artist expressed, a complete revelation for nearly all the rest of Europe. This collection has been arranged by Mr. James Fergusson, and forms an admirable pendant to the British gallery.

The picture galleries may now be said to be complete, with the exception of the placing the names and numbers on the frames, which is now being carried out; the last novelties there observed are eight frames containing some very curious specimens of Chinese art.

Additional interest has been given to the collection of pictures and drawings by the publication of the awards of the jury, which has been even more parsimonious than the Commission, the whole number of prizes awarded being but fifty-nine, or eight less than the number placed at its disposal.

Four of the grand prizes have been awarded to the French artists Meissonnier, Cabanel, Gérôme, and Théodore Rousseau; the four others to Leys, of Belgium; Kaulbach and Knauss, of Prussia; and Ussi, of Italy. First-class medals are given to Breton, Pils, Fromentin, Millet, Robert-Fleury, Brida, François and Daubiny, of France; to A. Stevens and Willems, of Belgium; Calderon, of England, Rosales, of Spain; Matejcko, of Austria; Horschelt and Piloty, of Bavaria. Second-class medals to Hébert, Corot, Jalabert, Jules Dupré, Brion, Gidé, Vauthier, Yvon, Hamon, Bonnat, Delaunay, and Rosa Bonheur, of France; Nicol, of England; Menzel, of Prussia; Sigismond l'Allemand, of Austria; and Claes, of Belgium. Third-class medals to Belly, Brisson, Charles Comte, Veffer, Baron, Bougereau, Levy, Cabals, de Curzon, and Puvis de Chavannes, of France; Adam, of Bavaria; Orchardson, of England; Gisbert, of Spain; Achenbach, of Prussia; Israels, of Holland; Wurzenger, of Austria; Faruffini, of Italy; Gonzalvo, of Spain; and the only prize for a water-colour drawing, to Walker, of England.

The horticultural competitions are going on regularly, and Messrs. Veitch and Son, of Chelsea-lane, won the first prize for a lot of fifty species and varieties of coniferous plants grown in the open air, and another first prize for new plants not yet disseminated.

The industrial juries have almost finished their examination, so that, with the exception of competitive trials in the classes of agriculture and horticulture, which will be spread over the whole period, the awards will all be made by the end of June.

The number of visitors is now very large, and the Exhibition has become the event of the day.

The following letter, addressed by Mr. Owen Jones, to the editor of the *Times*, will be found useful to all who visit the Exhibition:—

At the Exhibition of the Works of Industry of All Nations in 1851, the artistic world was startled by the revelation of the vast amount of elegance of design and propriety in its application exhibited in the works of the Oriental exhibiting countries. This impression was strengthened in the Exhibitions of 1855 and 1862, and in many directions the influence which Oriental art had exercised during the period which had elapsed since 1851 was recognised.

In the present Universal Exhibition of 1867 we still find India, Tunis, Egypt, and Turkey taking the highest rank in the application of art to manufactures. The shawls, carpets, mats, metal-work, and painted boxes of India; the embroidery of Tunis, and carpets of the Ottoman Empire, all exhibit the same unvarying principles of design, elegance, and refinement for which we sometimes look in vain in the art productions of European countries. By an unerring instinct and tradition they are able to apply ornament to the surfaces of objects they desire to decorate in the exact proportion and scale which the general form, material, and destination of such objects require. In the balance of colours, and in the distribution of lines of the ornament, they arrive at a perfection which it seems beyond the European mind to reach. To be fully satisfied of this it would be sufficient to compare the distribution of ornament on an Indian lacquer box of the humblest pretensions with the highest class enamelled works designed on Oriental principles exhibited by houses of justly European celebrity.

In the attempt which the French have made in the present exhibition to decorate some of the courts which contain the Oriental treasures in their own style we see how little the principles of decoration and ornamentation which the exhibited objects themselves display have been understood or appreciated by those who undertook the task. Ornaments have been misapplied in every direction, magnified from original sources out of all proportion, and mixed up with others of pure invention.

It would be a painful and invidious task to criticise in detail the decoration of these courts. To have rendered them worthy of the objects they enclose would have required years of preparatory study, and an amount of care and skill in the execution far beyond that which was at command, and which, perhaps, the temporary purpose which these decorations had to fill would hardly justify. I cannot therefore but regret that the attempt should have been made, feeling that it has cast an unmerited air of vulgarity over an art which is in reality so refined, and indisposed the casual observer to look within for that refinement and beauty which it overlays.

I am here led to the consideration of how far it is in any case desirable, in a building intended for such varied contents as an international collection, to attempt any decoration beyond that which the building itself may require; it is certainly not desirable to construct decoration.

In the building of 1851 there was, properly speaking, no decoration; beyond the colouring of the various constructive features of the building the objects exhibited were left to form the chief attraction, and themselves made up the decoration. In 1855 a little more was attempted; in 1862 too much, perhaps, of ornamentation, which in so vast a structure added little to the general effect that might not have been supplied as well or better by more simple means—in fact, the machinery annexe was an example of what might have been done with the main building in this direction.

The present building, from its peculiar plan and construction, may, for all practical purposes of effect, be said to have disappeared, as, with the exception of the grand avenue and the machine gallery, it nowhere enters into composition with the articles exhibited. It is not likely that the plan of this building would be followed in any future exhibition in England. The circular form evidently entails too many sacrifices of convenience and effect. But the zone system does appear to have many advantages, and we can conceive it carried out with parallel lines round a central hall with good results. In this central hall might be placed objects on which the various exhibitors might wish to stake their reputation and chance of reward, and which should have first passed a jury of selection. The present collection is too much like long lines of shops. Beside the many articles worthy of study there are far too many that a walk on the Boulevards would equally well bring to notice. Of course, exhibitors are desirous of showing examples of every variety of their manufacture; but international exhibitions should not be allowed to drift into mere commercial displays. They were intended to record the industrial progress of nations at various intervals of time, and objects which in no way exhibit this progress should be excluded, or, if that could not be done, they would, at least, find no admittance in our hall of honour.

We would venture to recommend the visitor who desires to study this exhibition with reference to the influence of art on manufactures, to commence his studies with the Oriental collections. When thoroughly impressed with the true principles of decoration and ornament, which he will find in these works, and carrying these principles in his mind during his visits to the collections of European countries, we feel assured that he will value these latter only so far as they observe the general laws of all art, which Orientals so instinctively follow—laws which were equally followed in all great periods of art, and which are to be found in all great works of the past. It is the neglect of these unvarying principles which leads so often to ugliness and bad taste in the incessant search of the present time after novelty, irrespective of fitness.

Doubtless the visitor will find throughout the international collection many objects to be admired, and many attempts to struggle against the fashion of the hour; but there are still by far too many violations of true art, too many instances of forms built up one on the other, without due regard to the proper transition from one form to the other; too many instances of impure form and discordant colouring; and we believe the visitor will return again and again to examine the lovely productions of the Indian looms, the delicate refined ornamentation of their metal and lacquer work. No object, however humble, appears to escape art influence. They seek not after novelty, yet every object is a new delight, as we feel how every touch of the pencil or the graver is directed by a mental action. Not a line is drawn that could be better placed in any other direction. Such as the mass is, so are the details. Not so with European works; they may more or less satisfy us, but there is always something to offend, and which we would desire to see otherwise than as we find it.

Fine Arts.

ADDITIONS TO THE LOUVRE.—Some recent acquisitions have been added to the galleries of the Louvre, including the "Birth of the Virgin Mary," by Murillo, and the "Sainte Appoline" of Zurbaran; three small works by Chardin; the portrait of Denon, the first keeper of the Louvre, by Prudhon; and a portrait of a woman by Madame Haudebourg Lescot.

A Centenarian Artist.—There are two pictures at present to be seen in the Salon, in Paris, painted by M. Jean F. M. de Waldeck, born at Vienna, in Austria, on the 16th March, 1766, and who was pupil of Vien, of David, and of Prudhon. These works were, according to the declaration of the artist, completed at the end of last year only.

Commerce.

Tea Cultivation in India.—It appears that there seems to be at last some likelihood of a settlement of this vexed question. A memorial from the tea planting interest in Eastern Bengal has been laid before the Government of India, and from the cordial reception accorded to the deputation, which was remarkably influential, representing eighty firms, thirteen companies, and six banks, the importance of the subject, and the magnitude of the interests involved in it, seem to be acknowledged by the officials. In urging their claims, not for any Government protection, but simply for permission to manage their affairs in the way most likely to be conducive to their own interests, the deputation refrained from imputing any blame to the Government, attributing their losses wholly to "mercantile speculation, bad management, and a malarious climate." As the same reasons for this reserve do not exist on the part of the public, inasmuch as they have no officials to conciliate, we *(Produce Markets Review)* need not hesitate to speak with more plainness on the subject, and to lay a considerable portion of the blame on the Indian Executive. If it be not in the power of Governments to aid the development of commerce, at least they should abstain from placing unnecessary obstacles in its path, and amongst these impediments the one-sided legislation on behalf of the coolies must undoubtedly be classed. Granted that the only object that the Government had in view was the protection of the inferior and weaker classes against the possible tyrannical exactions of the planters, still there were many other ways of effecting this desirable object without necessarily entailing ruinous losses on the planters at the same time. The most effectual means for facilitating communication between the coolies and the employers of labour would have been, as the memorialists point out, the formation of proper roads between Bengal and Assam or Cachar; as in that case all the expenses, risks, and diseases incidental to long voyages by steamer would have been obviated. "Tea coolies have to be recruited," we are informed, "kept in depôts in Calcutta or Kooshtea, conveyed in steamers to their destination, and exposed to the chance of neglect and the certainty of sickness, in a malarious climate, far away, in many cases, from public opinion, just as in the case of the colonies. It is true that self-interest in most cases, and high principle in a few, lead the tea-planter to care for a labourer whose importation alone has cost him £8 or £10, and without whom his garden would relapse into jungle. But certain as is the good treatment of the coolies on the whole, there have been cases of the opposite, and the interests of ill-paid and not always highly-cultivated assistant-planters in isolated gardens are not those of their employers, or at least so strong as to check occasional outbursts of temper. Government interference then is necessary, but only so long as emigration has to be carried on in crowds and river-steamers. The moment a road is made from Bengal to Assam, it is evident that coolies will find their way there just as they do to other districts. It is the old story of a want of communication, to which the Orissa famine, in its intensity and long continuance, may be traced no less than the Assam collapse." With a liberal disbursement of funds by the Indian Government for the formation of roads, all the evils alluded to above, and the necessity of any official interference with the labour question, would at once be done away with.

Cultivation of Hops.—Professor John Wilson, in his report on the agricultural exhibition held at Vienna last year, mentions that, along with the samples of Hungarian hops was shown a plan of the method of cultivation carried out at Bellye, adapted for all other districts where wood suitable for hop-poles is scarce. Wooden pegs or short stakes are driven into the ground, at such distances apart as it is intended to plant the vines; and at longer distances—usually about 20 to 25 yards—light poles are erected, with a height of from 12 to 15 feet above the surface, so that there are parallel lines all over the ground of short stakes or pegs placed at certain distances, and projecting about 8 to 12 inches in height, while parallel rows of poles, from 12 to 15 feet high, cross these at right angles, and at from 20 to 25 yards' distance apart. A stout wire is stretched horizontally from pole to pole all over the ground, while vertical wires or light rope, made of any suitable material, are attached to the pegs and carried up and fastened to the horizontal wires, thus offering a steady support to the hop vine during the period of growth. At harvest time the ropes are detached and carried to the picking stage with the vines, and the field cleared for the usual tillage operations without the trouble and expense of shifting, stacking, and resetting the poles. This plan has been carried out during several seasons at Bellye, and has been introduced into Wurtemberg. Baden, Bavaria, and other hop-producing countries, with satisfactory results.

Colonies.

English Capital in Australia.—From several sources of information it appears that English capital is finding an outlet in pastoral investments in Australia. Paragraphs have appeared in local journals announcing the transfer to British proprietaries of large squatting stations. This development has disclosed itself in Queensland, but to a much larger extent in Riverina. The movement is very desirable, and deserves every encouragement that can be given to it. An extensive transfer of stations to new and wealthy owners would be most beneficial. It would directly benefit nominal owners struggling with heavy liabilities; it would be advantageous to mortgagees, especially banking mortgagees, with advances locked up for indefinite periods, by bringing their capital once more within their reach and control; and finally (says a colonial journal), it would probably be a highly profitable mode of investment for the new purchasers if possessed of resources for properly and efficiently working these great properties. There are such solid profits to be made out of sheep and cattle stations, by persons with sufficient independent means, that once the introduction of English capital was set in motion its influx would be constant and regular. The sinking of wells and the formation of reservoirs would immensely increase the capability of the arid country now useless in the Riverine districts, and this is the preliminary outlay which many of the present station occupiers cannot afford. The loan and mortgage companies have done something in giving accommodation, but rich ownership would benefit the district more than the limited aid these corporations can give. The banks have lent millions of capital, drawn from Victorian depositors, upon the security of stations in Riverina. They should, by firmly applied pressure, compel squatting borrowers to throw themselves into the arms of a good class of purchasers.

Commerce between India and Australia.—An article in the *Madras Times* comments on some samples of wine lately shipped from Victoria by the Murray Valley Vineyard Company, and recognizes great improvement in their ripeness and quality, as compared with those for-

warded the previous year. It expresses an opinion that frequent drinkers of these unadulterated wines would prefer them to those of European vintages, adulterated to suit the English taste. It concludes by looking on to a not far distant time when India and Australia may be more closely connected by commerce than at present, and when the produce of Australian farms, runs, and vineyards will be exchanged for coffee, sugar, and other Indian productions.

Notes.

SCIENTIFIC SOCIETIES IN RUSSIA.—A Society of History was formed at the end of last year, in Saint Petersburg, with the view to the publication of materials relative to the history of Russia from the time of Peter the Great. The first meeting of the society took place on the 12th March, in the house of the Prince Gortchakoff, under the presidency of the hereditary Grand Duke; several important public documents were communicated to the meeting. The Geographical Society of Russia has been authorized to establish a section in the north-west, the seat of which will be Wilna; the chief object of this new section is to study the province in an archæological, statistical, and ethnographical sense. An ethnographical exhibition has been announced to take place at Moscow during holy week; the idea of thus collecting the illustrations of Slave ethnography has been very warmly taken up by the *savants* not only of Russia but of the adjoining populations speaking a Slave idiom; and it is said that the collection of drawings, photographs, arms, utensils, and other articles and illustrations, is extremely curious. Great arrangements were announced to have been made for the visitors expected from Austria and Turkey, who were to be lodged in thirty apartments prepared for them in the Hôtel Kochoreff.

MEDICAL CONGRESS IN PARIS.—A scientific medical congress is announced to open in Paris on the 16th of August, under ministerial patronage, to which all the medical world is invited. A committee, including Dr. Wurtz, dean of the Faculty of Medicine, Drs. Tardieu, Bouilland, and many more eminent physicians and surgeons, is appointed to organise the congress. The secretary, to whom all communications are to be addressed, is Dr. Jaccoud, of 4, Rue Drouot, Paris.

MONT CENIS TUNNEL.—According to the official report received by the Minister of Public Works at Florence, it appears that the boring works of the great tunnel of the Alps at Mont Cenis, on the north side of Modane, had passed, on the 8th of last March, the bed of quartz which had been met with in June, 1865, and they had passed through a schistose limestone, mixed, and were now in pure limestone. The length of quartz passed is 381 metres, approaching in a surprising degree to the 348 metres, estimated at the beginning according to the external appearances and the inclination of the beds. From the 8th of March the nature of the rocks has been always the same, and the advancement in the small tunnel, which in the quartz bed never exceeded on the average 15 metres a month, has almost entirely resumed its original progress. It is satisfactory to publish the results obtained in the two fortnights of March, results which show that the work of boring has gone on with regular development on both sides. Progress during the first fortnight in March in the small tunnel was—south side, 34·55 metres; north side, 19·37 metres, During the second fortnight in March—south side, 41·25 metres; north side, 38·17 metres. Total work in the month, 133·34 metres. Total length of the bored part—south side, 4,119 metres; north side, 2,528·25 metres; total, 6,647·25 metres. Total length of tunnel, 12,220 metres. Portions bored, 6,647·25 metres; remaining to bore, 5,572·65 metres.

INTERNATIONAL MONEY ORDERS.—In October, 1864, a convention was concluded between the French and Italian governments for the reciprocal transmission of money orders through the post-offices of the two countries for the payment of articles bought in France and Italy by private persons. A statement of the amount of orders sent by the French Post-office to Italy and by the Italian Post-office to France, and paid, from the 1st of October, 1864, to the 31st of December, 1866, shows that in October, 1864, the month in which the convention was concluded, there were 933 orders, amounting in all to about 53,000 francs, sent through the French Post-office to Italy. In December of last year this had increased to 3,519 orders, amounting to more than 180,000 francs. The orders sent from Italy to France were in October, 1864, 920, amounting to 69,000 francs, and in December last, 2,395, amounting to about 194,000 francs. "There can be no doubt," says the Paris correspondent of the *Times*, "that a similar arrangement between France and England would be mutually advantageous, and there is no comparison between the quantity of articles bought by Frenchmen in England and *vice versâ*, and those between France and Italy. For the convenience of both post-offices it might be stipulated that 200 francs, or £8, should be the *maximum* of the money order. I am assured that the French Postmaster-General declares himself ready and willing to sign such a convention, but some of the officials of the English Post-office are opposed to it—why, I cannot say."

THE EMPRESS EUGENIE is preparing two collections of pictures and other objects connected with the Empress Josephine and Marie Antoinette. When completed they are to be open to the public during the Exhibition, at the palaces of Malmaison and the Petit Trianon.

MEETINGS FOR THE ENSUING WEEK.

MON......Society of Arts, 8. Cantor Lecture. Mr. Chaffers, "On Pottery and Porcelain."
R. United Service Inst., 8½. Capt. T. E. Symonds, R.N., "The Combined End-on and Broadside System."
R. Geographical, 8½. 1. Capt. Sherard Osborn, R.N., "On Chinese Tartary." 2. Mr. A. G. Findlay, "On Dr. Livingstone's Last Journey, and the Sources of the Nile."
Society of Engineers, 7½. Discussion on Mr. Vaughan Pendred's paper, "On Water Tube Boilers."

TUES ...R. Medical and Chirurgical, 8½
Civil Engineers, 8. 1. Discussion upon Mr. Chance's paper, "On Optical Apparatus used in Lighthouses." 2. Mr. Edward Byrne, "Experiments on the Removal of Organic and Inorganic Substances in Water."
Photographic, 8.
Anthropological, 8.
Royal Inst., 3. Dr. Miller, "On Spectrum Analysis."

WED ...Society of Arts, 8. Mr. W. Fothergill Cooke, "On New Machinery for Cutting, Tunneling, Quarrying, and Facing Slate, Stone, and Marbles."
Pharmaceutical, 11. Annual Meeting.

THUR ...Zoological, 4.
Chemical, 8.
Syro-Egyptian, 7½. Mr. D. W. Nash, "On the Mutual Influence of Assyrian and Egyptian Civilisation."
Royal, 8½.
Antiquaries, 8½.
Royal Inst., 3. Prof. Huxley, "On Ethnology."
Numismatic, 7.
Royal Society Club, 6.
London Inst., 7. Prof. Bentley, "On Botany."

FRI ......Philological, 8. Annual Meeting.
Royal Inst., 8. Prof. Odling, "On the Absorption of Gases by Metals."
R. United Service Inst., 3. Captain G. Frederic Blake, "Military Law."

SAT ......Royal Inst., 3. Prof. Huxley, "On Ethnology."
R. Botanic, 3¾.

PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS.

Par. Numb. *Delivered on 18th April, 1867.*

175. Savings Banks—Return.
185. Government Insurances and Annuities—Accounts.
226. Education (Ireland)—Statement.

Delivered on 20th April, 1867.

196. New National Gallery—Letter.
203. Army (Recruiting)—Recommendations.
205. Waterford County Election—Minutes of Evidence.
224. Registrars' Fees (Middlesex)—Returns.
234. Malt and Barley—Returns.

Delivered on 25th April, 1867.

139. Tancred Charities—Report.
195. East Kent, &c., Railways—Estimate.
200. Waterford County Election—Depositions.
216. Waterford County Election—Orders.
229. Hops—Returns.
232. Population, Inhabited Houses, &c.—Return.

Agricultural Exhibitions (Vienna, &c.)—Report by John Wilson, Esq.
Ionian Islands—Despatches as to the state of Corfu, Zante, and Cephalonia, since the withdrawal of British protection.

Delivered on 26th April, 1867.

121. Bill—Local Government Supplemental.
142. Imperial Guarantees—Return.
199. (I.) Oyster Fisheries (Ireland)—Application.
230. Army—Statement.

Delivered on 27th April, 1867.

113. Bill—Customs and Inland Revenne.
122. Railways—Scotland.

Delivered on 29th April, 1867.

30. Bill—Railways (Guards and Passengers' Communication).
105. ,, Master and Servant.
123. ,, Land Drainage Supplemental.
118. (I.) Gas (Metropolis)—Correspondence.

Public General Acts—Cap. 11 to 16.

Delivered on 30th April, 1867.

111. Bill—Education of the Poor.
46. (III.) Trade and Navigation Accounts (31st March, 1867).
235. New Courts of Justice—Correspondence.

The "Queen Victoria"—Correspondence (Part II.).

Delivered on 1st May, 1867.

125. Bill—Vaccination.
211. Tipperary Election—Minutes of Evidence.

Education—Returns for the years 1859-1866.
Japan—Correspondence.
The "Tornado"—Correspondence (Part VII.)
Public Petitions—Eighteenth Report.

Delivered on 3rd May, 1867.

128. Bill—Tramways (Ireland) Acts Amendment.
167. Queen Anne's Bounty—Return.
233. Rangoon and Western China—Further Papers.

Delivered on 4th May, 1867.

215. Iron and Machinery—Return.
257. Civil Services—Abstracts of Sums Voted "on Account," and the Sums required to complete the several Grants.
193. East India (Upper Burmah)—Papers and Correspondence.

Fisheries (Ireland)—Report of Special Commissioners.
New Zealand—Further Papers.
Public Petitions—Nineteenth Report.

Delivered on 6th May, 1867.

134. Bill—Meetings in Royal Parks.
78. (VI.) Committee of Selection—Seventh Report.
154. Metropolitan Police (1866)—Accounts.
231. Wrecks (Ireland)—Return.
240. Board of Trade (Meteorological Department)—Return.

The Holy See and Rome—Further Papers.
Charity Commission—Fourteenth Report of Commissioners.

Delivered on 7th May, 1867.

130. Bill—Pier and Harbour Orders Confirmation.
209. County Court Commitments—Return.
239. East India (Mysore)—Further Papers
242. Merchant Shipping Tribunals—Memorials.
255. Navy (First Class Boys, &c.)—Return.
256. Army (Sneider's Rifle Ammunition)—Return.
259. Public Officers—Treasury Minute.
262. Constabulary (Ireland)—Return.
267. Railways (Session 1867)—Board of Trade Report.

Patents.

From Commissioners of Patents' Journal, May 3rd.

GRANTS OF PROVISIONAL PROTECTION.

Agricultural implements—1130—R. Boby.
Bathing apparatus—985—W. Clark.
Boxes—1144—J. E. Mellin and C. H. Ulbricht.
Clocks—1097—W. Clark.
Compasses—1098—R. Shortrede.
Cotton, &c., preparing—62—J. M. Hetherington.
Cotton, &c., preparing—1079—J. Higgins and T. S. Whitworth.
Cranes—1077—W. R. Lake.
Ear-stoppers—995—W. Clark.
Files—1112—G. T. Bousfield.
Fire-arms, breech-loading—1069—W. R. Lake.
Fire-arms, breech-loading—1075—S. Smith.
Fire-arms, breech-loading—1100—K. H. Cornish.
Fire-arms, breech-loading—1138—T. Horsley.
Fishing apparatus—1146—W. Wilkinson.
Fluids, measuring—1071—F. G. Fleury.
Furnaces—1142—W. Begg.
Iron, coating with zinc—1107—C. Crockford.
Iron, manufacture of—1087—W. H. Dawes.
Iron, &c., rolling—1095—T. H. Head.
Knife-cleaning machines—1126—J. Lewthwaite.
Latch, window—1106—R. S. M. Vaughan and A. G. Harston.
Locomotive figures, &c.—1083—J. J. Snow.
Looms 1063—J. Ratcliffe and G. Wolstencroft.
Looms—1092—R. L. Hattersley and J. Smith.
Looms—1140—W. and J. Holding.
Metals, cutting and polishing—410—J. Thompson.
Metals, grinding and polishing—1105—W. Gregory.
Metals, &c., oxidizing—1042—W. Henderson.
Mules, self-acting—1128—W. Weild.
Pans, cooking—1148—A. E. Griffiths.
Pianofortes—1136—A. N. Wornum.
Pressing iron—1065—F. Love, T. Davy, and J. Metcalf.
Printing machines—1093—C. H. Gardner and J. Bickerton.
Printing machines—1116—W. Clark.
Railway carriages, &c.—1110—J. Richardson and C. Greenwood.
Ranges—1103—J. Jobson.
Rudder pins, &c.—1108—C. Grace.
Screens, corn, &c.—1134—R. Boby.
Screws—1089—H. P. Boyd.
Sewing machines—1081—G. Slater.
Ships' propellers—1085—R. Courtenay.
Ships' propellers—1096—W. Clark.
Signals, railway—1032—J. Woods.
Stained glass, imitation of—1120—J. W. Breakell.
Steam engines—1124—D. Rankin.
Sugar, refining—1099—J. Aitken.
Tanning apparatus—1091—C. Wilmet.

PATENTS SEALED.

2871. J. R. Wigham.
2877. W. E. Newton.
2886. W. Darlow and P. W. Seymour.
2892. J. C. Newey.
2893. J. and M. Deavin and J. H. Sutton.
2896. J. E. Brown.
2905. T. Kershaw.
2908. J. Thomson.
2913. A. Giles and T. Sturgeon.
2928. H. A. Bonneville.
2966. C. Moseley.
2976. J. F. Belleville.
2979. C. M. Bathias.
2989. W. A. Lyttle.
3040. W. Chambers.
3225. W. Guest.
614. G. Haseltine.
623. W. E. Gedge.

From Commissioners of Patents' Journal, May 7th.

PATENTS SEALED.

2912. J. S. Cooke.
2920. S. W. Woodroffe.
2921. J. H. Johnson.
2922. F. B. Dœring.
2925. A. Gobert.
2932. G. Little.
2933. W. Robertson and C. J. Waddell.
2934. G. White.
2936. F. B. Donisthorpe.
2939. T. Skaife.
2942. J. G. Tongue.
2947. G. Crawshay & J. Thomas.
2948. G. Crawshay & J. Thomas.
2949. J. Denley.
2957. G. Crawshay & J. Thomas.
2965. G. Whitehead.
2973. F. W. Dähne & D. Thomas.
2999. T. B. Taft.
3004. E. Drucker.
3053. J. Tasker.
3062. J. Barker.
3100. W. Botwood.
3133. W. R. Lake.
3217. G. Haseltine.
55. W. E. Newton.
175. W. E. Newton.
537. J. R. Cooper.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

2671. R. Broadbent.
1257. A. B. Childs.
1612. W. Clark.
1146. G. Hodgson and A. H. Martin.
1163. W. Powell.
1194. J., J., and J. Booth.
1126. W. T. Henley.
1131. C. J. Richardson.
1140. W. Simpson.
1221. D. West.
1159. J. Cameron.
1132. J. Gardner, R. Lee, and G. H. Wain.
1151. A. Barclay.
1136. E. Beanes and C. W. Finzel.
1139. G. Haseltine.
1142. J. J. Miller, jun.
1154. F. Martin.
1162. J. R. Abbott.
1165. E. Heywood.

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

1124. J. Grimond.
1121. D. West.
1138. W. Evans.
1300. G. de Laire and C. Girard.